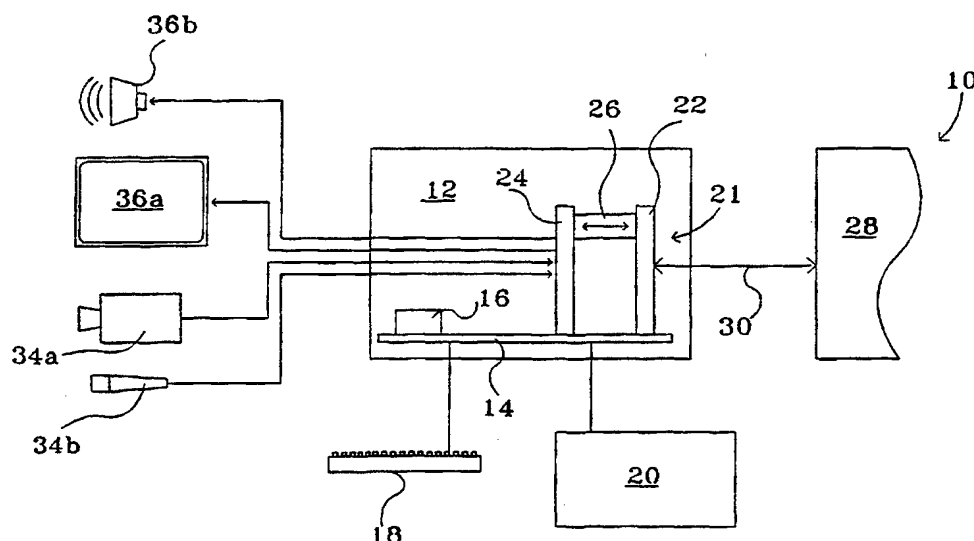


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(54) Title: MULTIMEDIA NETWORK SYSTEM WITH HIGH SPEED DATA BUS FOR TRANSFERS BETWEEN NETWORK INTERFACE BOARD AND VIDEO BOARD

**(57) Abstract**

A multimedia network system (10) for connection to a computer (12) and a computer network (28). Asynchronous transmission mode cells on the network (28) are processed by a network interface board (22) with synchronous signals routed to an ISOBUS (26) and asynchronous signals routed through a packet memory (24) to the computer (12). Asynchronous signals are routed through the ISOBUS (26) to a video board (24) and converted for output to one or more audio/video output devices (36). Signals originating at one or more audio/video input devices (34) are processed through the video board (24) and the network interface board (22) to the network (28).

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**MULTIMEDIA NETWORK SYSTEM WITH HIGH SPEED DATA BUS FOR TRANSFERS BETWEEN
NETWORK INTERFACE BOARD AND VIDEO BOARD**

TECHNICAL FIELD

The present invention relates generally to the field of electronic data communication and more particularly to a system for local and wide area transmission of video and text information. The predominant current usage of the multimedia network system is as a means for the exchange of information between a great variety of types of computerized devices such that information exchange is not limited by the type of computerized sending device or receiving device, nor by the nature of format of the digitized information to be exchanged.

BACKGROUND ART

The advent of the "information age" and the accompanying proliferation of computerized devices for generating and using digitized information has resulted a number of different machines and methods for the sharing of such information between users of such devices. This digitized information takes many different forms, including but not limited to digitized voice and other sound, digitized pictures (both moving and still) and data in many different formats. Given the great variety of types of digital data being generated, it is not surprising that quite a few methods for sharing such data have been devised, it being quite natural that different types of data might optimally be transmitted by different means. The most obvious, although certainly not the only, differences between the transmission requirements of disparate data types are the relative complexity of the data and the rapidity with which a quantity of data must be transmitted. Simple data transmission may be accomplished at relatively low rates while, at the other end of the spectrum, digital moving pictures require a wide bandwidth and high transmission frequency to update an image sufficiently quickly (even with the use of sophisticated data compression techniques).

In fulfillment of these various needs, local area network systems ("LANs") of various types have been developed for

1 communication over short distances, and a further variety of
2 wide area network systems ("WANs"), such as ARPANET, INTERNET,
3 and USENET, have been developed for communication over longer
4 distances. Fiber optic transmission systems, such as the
5 Fiber Distributed Data Interface ("FDDI") and Distributed
6 Queue Dual Bus ("DQDB") have been developed more recently.
7 Even networks that operate at gigabit (billion bits per
8 second) speeds and which consist of parallel connections
9 between computers, such as a network marketed by Ultra Network
10 Technologies, are available for linking supercomputers. At
11 the present time, special networks have also been implemented
12 for different services such as voice, data and video. While
13 some of these networks have been adaptable to more than one
14 data format, each has been restricted to only a limited
15 spectrum of data types and the various networks in common
16 usage are generally mutually incompatible.

17 While many single purpose data transmission means and
18 methods were well adapted for their intended purpose, it
19 became evident some time ago that it would be desirable to
20 transmit more than one type of data by the same means. One of
21 the first instances of this occurred in LAN type settings
22 wherein it was found to be desirable to be able to transmit
23 both voice and data over the same switched communications
24 lines. In response to the need to communicate a variety of
25 types of digital information, Integrated Services Digital
26 Networks ("ISDN") have been developed for communicating
27 integrated voice and data messages. However, early versions
28 of ISDN methods have been limited in bandwidth such that
29 moving pictures and other such time compacted information are
30 not amenable to transmission thereby. A standard for a
31 Broadband Integrated Services Digital Network ("BISDN") which
32 will have the necessary transmission capabilities is being
33 considered, and the International Telegraph and Telephone
34 Consultative Committee ("CCITT") has published a Study Group
35 XVIII Report R 34 with recommendations concerning BISDN.
36 Asynchronous Transfer Mode ("ATM") is the transfer mode for
37 implementing BISDN, and ATM is independent of the physical
38 means of transport of BISDN signaling. The essence of BISDN
39 is versatility, and so the proposals for its implementation

1 leave it up to independent inventors to devise means for
2 implementing communications in accordance with the proposed
3 functional criteria. According to paragraph 2.3 of the above
4 mentioned CCITT report, "The BISDN architecture is detailed in
5 functional terms and is, therefore, technology and
6 implementation independent".

7 Clearly, it would be advantageous to create a "technology
8 and implementation" which would implement digital
9 communications according to the BISDN defined functions. In
10 some small degree, such means are indirectly assumed by the
11 defined application. By specific intent, the detailed nature
12 of such means is not defined by the functions themselves.
13 Indeed, it is contemplated that a variety of such means may be
14 developed to accomplish various aspects of the defined
15 functions. While it may be relatively easy to implement
16 specific functions of BISDN, prior to the present invention a
17 means for more general implementation of these functions has
18 not been defined. Furthermore, while it might be a more
19 straightforward (although still quite complicated) engineering
20 task to bring about universal implementation of BISDN
21 functions through the use of very expensive high speed
22 computers which could provide the necessary processing power
23 to handle several broad bandwidth signals in parallel, prior
24 to the present invention there has been no general means of
25 implementation of BISDN which could be accomplished using
26 commonly available and relatively inexpensive small computing
27 devices such as personal computers and the like.

28 To the inventors' knowledge, no means for implementing the
29 range of BISDN functional capabilities has been developed.
30 All concepts for such means which have been advanced have been
31 either limited in functional capability or else have been too
32 expensive to implement for broad based consumer level
33 acceptance.

34 DISCLOSURE OF INVENTION

35 Accordingly, it is an object of the present invention to
36 provide means for communicating digitized information which is
37 relatively independent of the form or content of such
38 information.

39 It is another object of the present invention to provide a

1 means for communicating a variety of types of digitized
2 information which means is compatible with many existing data
3 communications means and methods.

4 It is still another object of the present invention to
5 provide a means for communicating digital information which
6 can transmit and receive communications having text, graphics,
7 data, image and moving picture information therein in
8 combination.

9 It is yet another object of the present invention to
10 provide a means for communicating digital information which is
11 adaptable for use with commonly available computers.

12 It is still another object of the present invention to
13 provide a means for communicating digital information which is
14 inexpensive to produce.

15 It is yet another object of the present invention to
16 provide a means for communicating digital information which is
17 adaptable to essentially any function contemplated by proposed
18 BISDN functional criteria.

19 Briefly, the preferred embodiment of the present invention
20 is a multimedia network system having a plurality of interface
21 units communicating with each other, with user computer input
22 and output devices, and with the network through three
23 distinct physical channels. Communication with the network is
24 through a Synchronous Optical Network ("SONET") Interface.
25 Communication with a host computer/controller is through a
26 host bus interface, and communications with other interface
27 units is through a unique Iso-Channel Bus ("ISOBUS"). In
28 addition, communication with input and output devices may be
29 made directly to the interface units thus, avoiding the
30 necessity of requiring such communications to be directed
31 through a host computer/controller. In the best presently
32 known embodiment of the invention, a network card communicates
33 directly with the network and a video card communicates with
34 video and audio input and output devices. Both the network
35 card and the video card communicate with and are controlled by
36 the host computer/controller through the host bus interface,
37 and communication between the video card and the network card
38 is via the ISOBUS.

39 An advantage of the present invention is that a great

1 variety of types of digital information may be communicated
2 thereby.

3 A further advantage of the present invention is that it
4 may be used in conjunction with commonly available personal
5 computers and other inexpensive computer devices.

6 Yet another advantage of the present invention is that
7 existing data communications means and methods may be
8 integrated to communicate through a single data terminal.

9 Still another advantage of the present invention is that
10 it is inherently relatively inexpensive to produce.

11 Yet another advantage of the present invention is that it
12 uses inexpensive peripheral devices.

13 Still another advantage of the present invention is that
14 the universality of application will improve economies of
15 scale, thus further reducing cost to the consumer.

16 Yet another advantage of the present invention is that it
17 can provide high quality moving picture video communications
18 while also communicating voice and/or other data.

19 These and other objects and advantages of the present
20 invention will become clear to those skilled in the art in
21 view of the description of the best presently known mode of
22 carrying out the invention and the industrial applicability of
23 the preferred embodiment as described herein and as
24 illustrated in the several figures of the drawing.

25 BRIEF DESCRIPTION OF THE DRAWING

26 Fig. 1 is a block diagram of a multimedia network system
27 according to the present invention;

28 Fig. 2 is a block diagram of the network interface board
29 of Fig. 1;

30 Fig. 3 is a block diagram of the video board of Fig. 1;

31 Fig. 4 is an example network configuration employing the
32 inventive multimedia network system;

33 Fig. 5 is a block diagram of an example of the broadband
34 information server of Fig. 4; and

35 Fig. 6 is a more detailed block diagram of the SONET
36 interface of Fig. 2.

37 BEST MODE FOR CARRYING OUT INVENTION

38 The best presently known mode for carrying out the
39 invention is multimedia network system for interfacing a BISDN

1 network to a network terminal. The predominant expected usage
2 of the inventive multimedia network system is in the data
3 processing and communications industry, particularly in end
4 user terminals wherein the ability to process a digital
5 information in a great variety of formats is desirable.

6 The multimedia network system of the presently preferred
7 embodiment of the present invention is illustrated in a block
8 diagram in Fig. 1 and is designated therein by the general
9 reference character 10. The multimedia network system 10 has
10 a computer 12 with a computer bus 14 therein. As will be
11 discussed in more detail hereinafter, it is intended that the
12 inventive multimedia network system 10 be adapted for usage
13 with a variety of computers 12 and computer buses 14. By way
14 of example, in the best presently known embodiment 10 of the
15 present invention, the computer bus 14 is a microchannel bus.
16 As will be evident to one skilled in the art, the computer 12
17 has a central processing unit ("CPU") 16 connected to the
18 computer bus 14 for processing data provided from the computer
19 bus 14 and returning processed data to the computer bus 14.
20 Other conventional peripheral devices in the best presently
21 known embodiment 10 of the present invention include a
22 keyboard 18 and a printer 20 for input and output,
23 respectively, of data to and from the computer 12. Additional
24 data input and output means such as scanners, pen type input
25 devices, and the like (not shown) may also optionally be
26 provided as required by the application.

27 At the heart of the best presently known embodiment 10 of
28 the present invention is a network interface subsystem 21
29 having a network interface board 22 and a video board 24. As
30 can be seen in the view of Fig. 1, the network interface board
31 22 and the video board 24 are each connected directly to the
32 computer bus 14. The video board 24 and the network interface
33 board 22 are further connected to each other through an ISOBUS
34 26. The ISOBUS 26 is a slotted time domain multiplexed data
35 bus for transport of constant bit rate services (such as ATM).
36 In the best presently known embodiment 10 of the present
37 invention, the ISOBUS 26 is a 16 bit wide bus operating at a
38 basic clock rate of 38.88 MHz. Transmission on the ISOBUS 26
39 is time divided into 8848 slots (plus a spare 11 clocks

between frames). The signals on the ISOBUS 26 are the 16 data lines, the 38.88 MHz clock, a frame clock, and a payload signal. For the sake of versatility in application, in the best presently known embodiment 0 of the present invention it is required that any device connected to the ISOBUS 26 (the network interface board 22 and the video board 24 in the example of Fig. 1) be capable of providing the clock signals, however only one is chosen to do so at any given time. The payload signal is driven by whichever device is assigned the transmit function.

The network interface board 22 is connected to a BISDN network through one or more network interface connections 30. In the best presently known embodiment 10 of the present invention, the network interface connection 30 is a fiber optic cable, although it is envisioned that other physical carriers having sufficient bandwidth might be employed for this purpose in the future.

Optionally connected to the video board 24 are a plurality of audio/video input devices 34 and/or an additional plurality of audio/video output devices 36. As can be seen in the view of Fig. 1, the best presently known embodiment 10 of the present invention has a video camera 34a and a microphone 34b as audio/video input devices 34, and a video monitor 36a and a speaker 36b as audio/video output devices 36.

Fig. 2 is a more detailed block diagram of the network interface board 22. As can be seen in the view of Fig. 2, a Synchronous Optical Network ("SONET") interface 38 converts fiber optic signals carried on the network interface connection 30 to electrical signals employed within the network interface board 22, and vice versa (data flow is bidirectional in the network interface connection 30. The SONET interface 38 will be discussed in more detail hereinafter. Data flow on the network interface connection 30 is in the form of ATM cells. Alternative ATM cell structures are defined beginning at page 90 of the aforementioned CCITT report. Incoming data (now embodied as electrical signal ATM cells) is sent to an input buffer 40 which, in the best presently known embodiment 10 of the present invention is a 512 X 16 bit FIFO buffer. From the input buffer 40 incoming

1 data is provided to a segmentation and reassembly - receive
2 unit ("SARA-R") 42. The SARA-R 42 is an ATM reassembly
3 processor for reassembling incoming ATM cells (received from
4 the input buffer 40) into their original signal format(s) and
5 separates constant bit rate streams for the ISOBUS 26, and is
6 a unit commercially available from TransSwitch Corporation. In
7 accordance with the normal operation of the SARA-R, a
8 reassembly control memory 44 is provided.

9 Reassembled signals from the SARA-R 42 are provided onto a
10 receive bus 46. Constant Bit Rate signals on the receive bus
11 46 are recognized and buffered at a plurality (16 in the best
12 presently known embodiment 10 of the present invention, of
13 which 5 are depicted in the simplified view of Fig. 2) of CBR
14 receive buffers 48. From the CBR receive buffers 48 the CBR
15 signals are converted from 32 bit to 16 bit format at a 32/16
16 bit convertor 50, and are then provided (now in 16 bit form)
17 to an IsoChannel interface 52 (since there are multiple
18 instances of an IsoChannel interface 52 in the best presently
19 known embodiment 10 of the present invention, the present
20 instance is designated herein as a network board IsoChannel
21 interface 52a). The network board IsoChannel interface 52a
22 interfaces the CBR signals to the ISOBUS 26.

23 One skilled in the art will recognize that CBR signals
24 (otherwise known as synchronous signals) include most forms of
25 video signaling wherein data flow can be defined in units of
26 fixed length. Asynchronous signals, on the other hand, are
27 defined as being provided in "packets" of relatively
28 indeterminate length. As one example, LAN signaling (as in
29 the ETHERNET protocol) is generally accomplished using packet
30 signals. In the best presently known embodiment 10 of the
31 present invention, packet signals are picked up from the
32 receive bus 46 by a packet memory 54. The packet memory 54 is
33 a 256 x 36 bit DRAM with a receive port 56, a send port 58 and
34 a host bus port 60.

35 From the packet memory 54, asynchronous signals are
36 communicated through the host bus port 60 to a host bus 62.
37 The host bus communicates through a host bus interface 64 of
38 the network interface board 22 to the computer bus 14 of the
39 computer 12 (Fig. 1) which, as previously discussed, is a

1 microchannel bus in the best presently known embodiment 10 of
2 the present invention. Since there are multiple instances of
3 a host bus interface 64 in the best presently known embodiment
4 10 of the present invention, the present instance is
5 designated herein as a network board host bus interface 64a).
6 Asynchronous signals from the packet memory 54 are routed and
7 processed by the computer 12 in conventional manner according
8 to the specific type of asynchronous signal involved. In
9 general, the fact that the asynchronous signals are introduced
10 to the computer bus 14 via the network board 22 (as opposed to
11 a board specifically adapted for interface of just one
12 specific type of asynchronous signal) will not be of relevance
13 to the manner in which the computer 12 processes such
14 asynchronous signal(s). Asynchronous signals generated by the
15 computer 12 will be returned through the computer bus 14 and
16 the network board host bus interface 64a to the packet memory
17 54 (through the host bus port 60 thereof).

18 From the packet memory 54 outgoing asynchronous signals
19 are output through the send port 58 to a send bus 66.
20 Synchronous signals coming from the ISOBUS 26 are returned
21 through the network board IsoChannel interface 52a and then
22 through a 16/32 bit convertor 68 to a CBR send buffer 70. From
23 the CBR send buffer 70 the outgoing synchronous signals are
24 provided to the send bus 66. Signals on the send bus 66
25 which, as previously discussed include both synchronous
26 signals from the IsoChannel bus 26 and asynchronous signals
27 from the packet memory 54 are provided to a SARA-S 72.

28 The SARA-S 72 is a processor, available from the same
29 source as is the SARA-R 42, for assembling digital signals
30 into ATM cells. As is customary for the functioning of the
31 SARA-S 72, a segmentation control memory 74 is provided.
32 Outgoing ATM cells (signals) are buffered at an output buffer
33 76 on their way to the SONET interface 38 for conversion to
34 fiber optic signals for output to the network interface
35 connection 30.

36 CBR data and packet data are kept from clashing on the
37 send bus 66 because, when CBR data is present the SARA-S 72 is
38 interrupted (CBR data being given higher priority than packet
39 data). If there is no CBR data on the send bus 66 or in the

1 output buffer 76 then the SARA-S 72 sends packet data from the
2 send port 58 of the packet memory 54 if there is any to send.
3 Otherwise, the SARA-S 72 sends empty ATM cells.

4 As can be seen in the view of Fig. 2., and as can be
5 appreciated by one skilled in the art, the host bus 62
6 communicates with the packet memory 54, the network board
7 IsoChannel interface 52a, the network board host bus interface
8 64a, the input buffer 40, the output buffer 76, the SARA-R 42,
9 the SARA-S 72, the reassembly control memory 44 and the
10 segmentation control memory 74 for operation under control of
11 the CPU 16 (Fig. 1) of the computer 12.

12 Fig. 3 is a more detailed block diagram of the video board
13 24 of Fig. 1 according to the best presently known embodiment
14 10 of the present invention. It should be noted that, in some
15 limited applications where video and/or audio input and/or
16 output is not required, it will not be necessary to include a
17 video board 24. However, where video or audio input or output
18 is required the video board 24 according to the best presently
19 known embodiment 10 of the present invention will be used in
20 the multimedia network system 10. Since it is a primary
21 purpose of the present invention to enable video and audio
22 input and output, it is anticipated that in most applications
23 the video board 24 will be included, as illustrated herein.

24 As has been previously discussed, the video board 24 is
25 connected both to the computer bus 14 and to the ISOBUS 26.
26 The video board 24 according to the best presently known
27 embodiment 10 of the present invention is conceptually divided
28 into three functional subsystems: an input subsystem 78, an
29 interface subsystem 80 and an output subsystem 82.

30 A plurality (two, in the example of Fig. 3) of audio
31 inputs 84 are provided to an audio input processor 86 and then
32 to an input audio control unit 88. In the best presently
33 known embodiment 10 of the present invention, the audio input
34 processor 86 is adapted for accepting Audio Engineering
35 Society ("AES") stereo standard inputs and ALaw or ULaw audio
36 inputs (ALaw and ULaw audio are the designations of the data
37 formats used in conventional digital telephony). The audio
38 input processor 86 converts analog audio signals to digital.

39 An additional plurality (two, in the example of Fig. 3) of

1 video inputs 90 are provided to a video A/D convertor 92, a
2 color decoder 94 and a pixel decimation unit 96. The color
3 decoder 94 converts raw digitized video into conventional
4 YUV4,1,1 format.

5 The pixel decimation unit 96 removes data from the digital
6 video image (as by eliminating every other line and every
7 other pixel from the remaining lines of the image) to reduce
8 the amount of digital information that must be transmitted.
9 This process, of course, reduces the image quality somewhat,
10 but this is a desirable trade off in many applications. As
11 indicated in the view of Fig. 3, a bypass 97 is provided for
12 selectively (under control of the computer 12) bypassing the
13 pixel decimation unit 96. In many instances of application,
14 high quality video is not required and the data additional
15 data compression provided by the pixel decimation unit 96 is
16 most desirable. However, in some applications (such as video
17 product brochures and negotiation conferences wherein it is
18 desirable to closely view the party with whom one is
19 communicating) it will be desirable to bypass the pixel
20 decimation unit 96 to allow full quality video.

21 Processed audio and video signals are provided to a video
22 board IsoChannel interface 52b in the interface subsystem 80
23 of the video board 24. Also, as can be seen in the view of
24 Fig. 3, the audio input processor 86, input audio control unit
25 88, color decoder 94 and pixel decimation unit 96 operate
26 under control data (generated by the CPU 16 (Fig. 1) of the
27 computer 12) and provided through the computer bus 14 and a
28 video board host bus interface 64b of the interface subsystem
29 80.

30 Video and audio signals (in digital format, as previously
31 discussed in relation to the network interface board 22) are
32 also received over the ISOBUS 26 and forwarded to the output
33 subsystem 82. In the best presently known embodiment 10 of
34 the present invention, since only two components, namely the
35 network interface board 22 and the video board 24 are
36 connected to the ISOBUS 26, signals arriving at the video
37 board 24 on the ISOBUS 26 must necessarily have been produced
38 to the ISOBUS 26 from the network interface board 22.
39 However, it is contemplated by the inventors that, in at least

1 some applications, there may be additional devices
2 contributing to or receiving signals to and from the ISOBUS
3 26, and the present invention is not restricted to this
4 specific limitation of the best presently known embodiment 10.
5 Also, as can be seen in the view of Fig. 3, the output
6 subsystem 82 operates according to control data received from
7 the computer bus 14 and forwarded through the video board host
8 bus interface 64b.

9 The output subsystem 82 of the video board 24 has an
10 output audio control unit 98 and an audio output processor 100
11 for converting the digitized audio arriving at the video board
12 24 on the ISOBUS 26 into a conventional analog audio output
13 102. In the best presently known embodiment 10 of the present
14 invention, the audio input processor 86 and the audio output
15 processor 100 are actually physically embodied together in the
16 same mechanical package, although this is not a necessary
17 aspect of the invention.

18 Also in the output subsystem 82 are a pixel expansion unit
19 104 for restoring missing data from images that have been
20 pixel decimated (discussed previously herein in relation to
21 the pixel decimation unit 96). As indicated in the block
22 diagram of Fig. 3, a second bypass 97 is provided for
23 bypassing the pixel expansion unit for those applications
24 wherein it is not necessary to reconstitute a pixel compressed
25 image. The output subsystem 82 further has a color space
26 convertor 106, a video ram 108, a video D/A and multiplexer
27 110 and a windowing engine 112.

28 As discussed in part above, the pixel expansion unit 104
29 adjusts incoming decimated video signals to simulated PAL/NTSC
30 and YUV4,1,1 signals. The color space convertor 106 converts
31 YUV4,1,1 to conventional RGB. The resulting RGB encoded data
32 is temporarily stored in the video ram 08 to be acted upon, as
33 requested by the operator via software drivers, by the
34 windowing engine 112 to provide a video output to the video
35 monitor 36a (Fig. 1). The video D/A and multiplexer 110
36 converts the RGB into conventional VGA analog format and
37 further mixes data incoming from the BISDN network 28 (Fig. 1)
38 with additional video signals incoming from video inputs 90
39 and/or video supplied by the computer 12 (Fig. 1).

1 A video output 114 is provided from the video D/A and
2 multiplexer 110 to the video monitor 36a (Fig. 1). In the
3 best presently known embodiment 10 of the present invention,
4 the video output 114 is a conventional Super Video Graphics
5 Array ("SVGA") compatible signal.

6 Fig. 4 is an example network 116 configuration employing a
7 the multimedia network systems 10. The quantity and
8 arrangement of each of the components in the illustration of
9 Fig. 4 is for the purpose of example only, and is not intended
10 to be limiting. The network 116 in the example of Fig. 4 has
11 a plurality (two in the example of Fig. 4) of Local Area
12 Networks ("LANs") 118, a conventional (non-multimedia) work
13 group LAN 120, and a media resource center 122 connected to an
14 Asynchronous Transfer Mode ("ATM") switch 124 by a plurality
15 (four in the example of Fig. 4) of BISDN busses. The ATM
16 switch 124 is further connected to a public switched network
17 130 by an additional BISDN bus 128, an ISDN bus 132 and a
18 switched multi-megabit data service ("SMDS") bus 134 to
19 provide flexibility in communications with the public switched
20 network.

21 In the multimedia work group LANs 118, computers 20 (the
22 term computers 20 is used generally here, as one skilled in
23 the art will recognize that workstations on a LAN can consist
24 of computerized devices, point of sale terminals and related
25 devices being examples, which are generally not specifically
26 referred to as computers) are connected within in the
27 multimedia LANs 118 through a matching plurality of the
28 network interface subsystems 21 by isochronous, high
29 bandwidth, busses which meet IEEE 802.6 standards ("IEEE 802.6
30 busses") 138. As used herein, the term "isochronous" refers
31 to a transmission mode which pre-allocates regular, periodic
32 transfer slots on a link. Fixed length ATM cells are used as
33 the common transport mode throughout the multimedia LANs 118.

34 To provide backward compatibility, the conventional non-
35 multimedia LAN 120 is connected to the ATM switch 124 (through
36 the associated BISDN bus 128) by a router 40. The computers
37 20 of the non-multimedia LAN 120 are connected to one another
38 and to the router 140 by a bus conforming to IEEE 802.3
39 standards ("IEEE 802.3 bus") 142.

1 The media resource center 140 in the example of Fig. 4 has
2 therein a broadband information server ("BIS") 144.

3 The multimedia LANS 118 support the capture, storage,
4 transfer and display of audio and video digital data streams
5 (as well other types of digitally encoded information) in a
6 networked environment. The network 116 including the
7 multimedia LANS 118 enables networked video conferencing,
8 audio video databases, and the like, within the network 116.

9 An example of the BIS 144 of Fig. 4 is illustrated in
10 block schematic form in Fig. 5. As can be appreciated in
11 light of the above discussion, the BIS is intended to provide
12 video information, upon demand, to other devices connected to
13 the network 16 (Fig. 4). In the example of Fig. 5, the BIS
14 144 is equipped with a plurality (four in the example of Fig.
15 5) of audio/video input devices 34 (examples of which have
16 been discussed previously herein in relation to Fig. 1)
17 providing input through an analog crossbar switching matrix
18 146 to a plurality (four in the example of Fig. 5) of the
19 network interface subsystems 21 previously discussed in
20 relation to Fig. 1. As described, each of the network
21 interface subsystems 21 is equipped with a video board 24 and
22 a network interface board 22. As previously discussed herein
23 in relation to Fig. 4, output from the BIS 144 is provided to
24 the ATM switch 124 for distribution to the network 116 (not
25 shown in the view of Fig. 5). A control unit 50 is provided
26 for controlling the analog crossbar switching matrix 146 and
27 the network interface subsystems 21, as previously discussed
28 herein. A mass storage unit 150 is provided for storing the
29 audio/video information acquired from the audio/video input
30 devices 34 such that it can be sent out to the network 116
31 upon demand.

32 Fig. 6 is a block diagram showing the makeup of the SONET
33 interface 38 of Fig. 2 as it is constructed in the best
34 presently known embodiment 10 of the present invention. As
35 can be seen in the view of Fig. 2. The SONET interface 38 has
36 an optical transceiver 152 for receiving and transmitting
37 optical signals. Although it was not originally intended for
38 this sort of application, a transceiver commonly available
39 from Sumitomo has been adapted as the optical transceiver 152

1 in the best presently known embodiment 10 of the present
2 invention. A receiver 154 is provided for accepting signals
3 from the optical transceiver 152 and forwarding them to a
4 field programmable gate array ("FPGA") 156 and a SONET
5 termination unit 158. The receiver 154 is part number S3006
6 supplied by AMCC and is designed specifically for operation in
7 accordance to SONET OC-3 specifications. As can be discerned
8 in more detail in the specifications available from the
9 manufacturer, the receiver 154 provides clock separation,
10 serial to parallel conversion, frame synchronization, loss of
11 signal sensing, frame loss alarming ECL to TTL level
12 translation and both line and terminal loop back capability.
13 The SONET termination unit 158 is a part number SOT-3
14 available from TransSwitch. SONET functions are provided by
15 the SONET termination unit 58 in accordance with the design
16 intent of the manufacturer. The FPGA is a type 1224 field
17 programmable gate array available from ACTEL.

18 Also provided in the BIS 144 is a transmitter 160 for
19 receiving signal from the FPGA 156 and forwarding it to the
20 optical transceiver 152. The transmitter 160 is part number
21 S3005 available from the same source as previously cited for
22 the receiver 154. The transmitter, 154 provides parallel to
23 serial conversion, clock generation, terminal and line
24 loopback, TTL to ECL translation and line encoding functions.
25 A crystal oscillator 162 is provides a reference clock for the
26 SONET interface 144 and the master clock for CBR functions on
27 the network interface board 22 (Fig. 1). (As previously
28 discussed herein, each board connected to the ISOBUS 26
29 should, according to the best presently known embodiment 10 of
30 the present invention, be capable of providing system clock.

31 In order to completely disclose the present invention for
32 the benefit of those skilled in the art who wish to understand
33 the exact manner in which the best presently known embodiment
34 10 of the present invention carries out the inventive method
35 and means, a detailed description of the communication
36 protocol for the ISOBUS 26 is included herewith as appendix A
37 hereto. A detailed description of the remainder of the data
38 communications protocols operating within the network
39 interface subsystem 21 is included as appendix B hereto.

1 As is shown above, in great part, the multimedia network
2 system 10 according to the present invention provides a means
3 for implementing communications within and between a great
4 variety of computer devices, and both within and between a
5 variety of computer networks and other computer
6 interconnection means. Among the substantial differences
7 between the present inventive multimedia network system 10 and
8 the prior art are the inclusion in the network interface board
9 22 of the enabling means described herein for communicating
10 both synchronous and asynchronous data in a manner such that
11 the differentiation between data types is essentially
12 transparent to the user. Furthermore, the unique division of
13 functions between the network interface boards 22 and the
14 video boards 24, and the unique ISOBUS 26 for transmitting
15 high speed CBR data therebetween provide a level of
16 versatility of data communications unknown in the prior art,
17 particularly since the video boards 24 and the network
18 interface boards 22 can be used in various combinations and
19 quantities according to the needs of a particular application,
20 as previously discussed herein in relation to the BIS 144.
21 Circuitry details of the present invention are conventional
22 given the functional descriptions and interrelationship of the
23 various components described herein, and no significant
24 changes of materials are envisioned nor are any special
25 constructions required.

26 Various modifications may be made to the invention without
27 altering its value or scope. As just one example, as
28 increasing production quantities of the inventive multimedia
29 network systems 10 permit, it should be possible to combine
30 functions described herein as being embodied in separate
31 subunits into integrated circuit packages.

32 All of the above are only some of the examples of
33 available embodiments of the present invention. Those skilled
34 in the art will readily observe that numerous other
35 modifications and alterations may be made without departing
36 from the spirit and scope of the invention. Accordingly, the
37 above disclosure is not intended as limiting and the appended
38 claims are to be interpreted as encompassing the entire scope
39 of the invention.

INDUSTRIAL APPLICABILITY

The multimedia network system 10 is intended to be widely used in a great variety of digital data communications. Indeed, it is difficult to point to one specific intended usage that would be more likely to predominate over others. As just an example, the inventors are developing an application wherein department store point of sales terminals could be connected to a central data base by means of the inventive multimedia network system 10. In such an application, not only could the purchaser's credit data be made available in real time, and the purchaser's account updated as the sale is made, it would even be possible to display the user's picture at the point of sale (to verify identification) and/or to transmit an image of the user's fingerprint from the point of sale for computerized comparison to data base fingerprints. As the science of retinal laser identification is perfected, this means of identification could also be added to the system.

Additional prospective applications range from the communication of weather radar images to interested weather observers (in which case, a radar unit (not shown) would be added as an additional audio/video input device 34) to the accomplishment of more mundane tasks such as computerized "shop at home" services, and the like.

The present inventive multimedia network system 10 has application for both "on line" type services such as bulletin boards (wherein the user is charged for time on the system) and "on demand" services wherein the user is charged a fixed fee for a transaction (or a fixed purchase price, or the like).

In summary, it is the very purpose of the present invention not to be restricted by the type of data which it is desired to communicate. Therefore, the industrial applicability should be limited only by the imagination of the users of the invention. A more detailed discussion of how the present invention might interface with the several emerging related technologies is included her as appendix C hereto.

The multimedia network system 10 of the present invention may be utilized in any application wherein a conventional

1 computer data communications means are used. Furthermore, the
2 inventive multimedia network system 10 is expected to create
3 new applications wherein the communication of digital
4 information might be useful.

5 Since the multimedia network system 10 of the present
6 invention may be readily constructed and may be adapted for
7 use with existing computer equipment and other existing
8 peripheral devices it is expected that it will be acceptable
9 in the industry as a substitutes for existing data
10 communications means. For these and other reasons, it is
11 expected that the utility and industrial applicability of the
12 invention will be both significant in scope and long-lasting
13 in duration.

APPENDIX A

IsoChannel Timing

9/30/92

Basic Clock Rate: 38.88 MHz or 25.720164 nS

Isochannel Time Zones = 169 per second

Tcl = IsoChannel Cell Period = 26 clocks @ 25.720164 nS
 = 668.724 nS

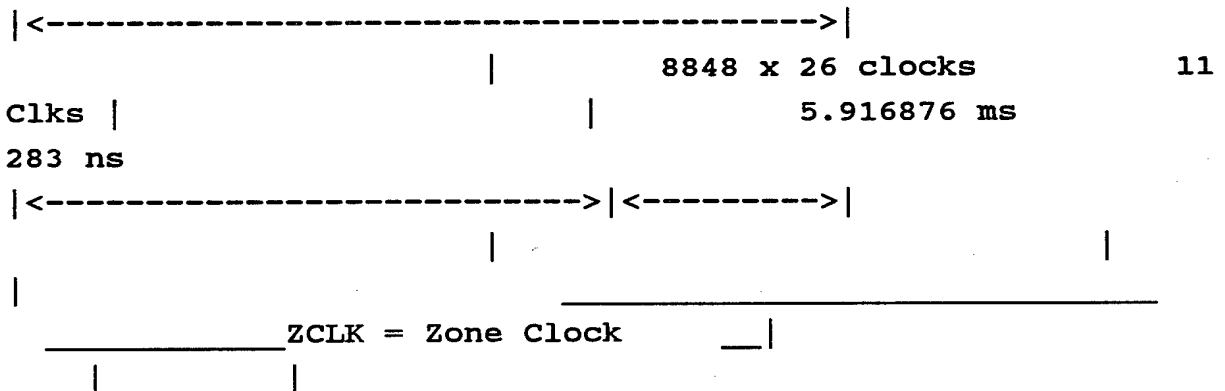
Ttz = IsoChannel Time Zone Period = 1/169 = 5.917159 ms

Ncz = Number of Cell Periods per Time Zone = Ttz/Tcl

Ncz = 5.917159 ms/668.724 nS = 8848.432238

Ncz = 8848 + (.432238 * 26 clocks / Cell Period)
 = 8848 + 11 Clocks

Ttz = 5.917159 ms



For an overview of IsoChannel sequencing see Dwg. #CBM-B102

ICSRAM: Isochannel Scheduling

IsoChannel traffic is governed by the schedule of isochronous cell traffic at the IsoChannel. One cell period at the IsoChannel consists of 26 clocks. 24 clock times are used to transfer cell data two bytes wide and two clock times are used for overhead. Each cell time is associated with one

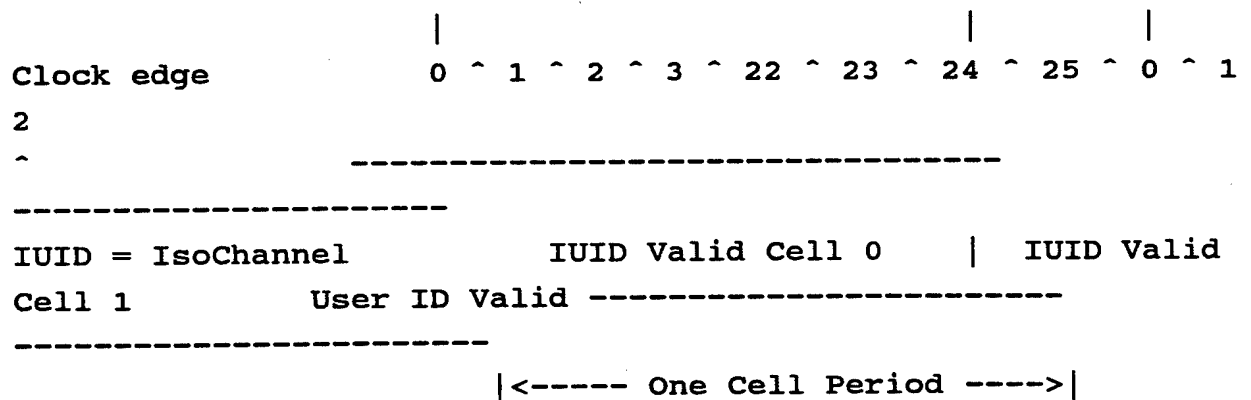
of 64 IsoChannel users, identified by a six bit IsoChannel User ID field (IUID).

Each circuit board residing on the IsoChannel is controlled by three enable signals, the 38.8 MHz bus clock and a special control RAM called the IsoChannel Scheduling RAM (ICSRAM). The ICSRAM are individually written and maintained by the host as new CBR virtual circuits are established and torn down. Each RAM uses 8848 locations, coinciding with the 8848 IsoChannel cell periods and cycles through all locations in one IsoChannel Time Zone Period.

Each IsoChannel board is assigned one (or several) IUIDs and looks for that ID at the output of the ICSRAM to determine when to talk, listen or idle. The RAM is byte wide, 6 bits for the IUID and 2 control bits encode the expected activity. The two control bits are encoded as follows:

<u>Bit 7</u>	<u>Bit 6</u>	
0	0	Idle
0	1	Talk: Write data to the bus
1	0	Listen: Read data from the bus
1	1	Talk and listen (used for testing)

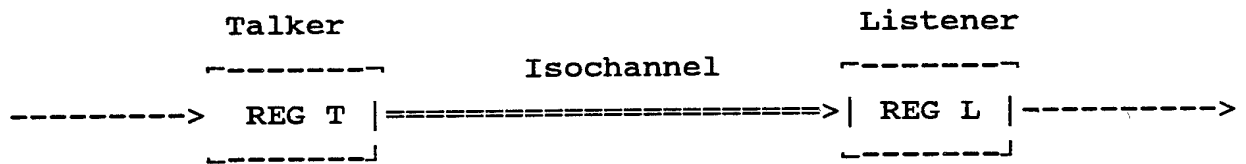
The ICSRAM address counter is updated two clocks prior to the start of a cell period, to allow time for the logic to prepare for the upcoming cycle. The address counter is reset during the low time of ZCLK.



IsoChannel Data Path

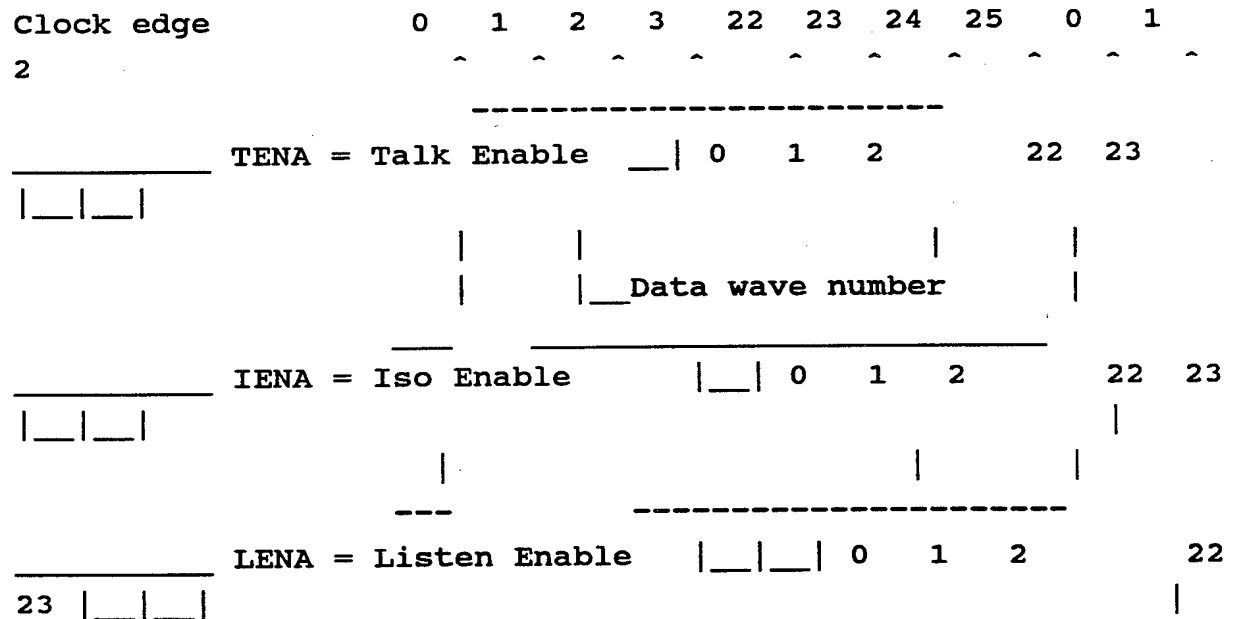
The IsoChannel data path is implemented as the three deep pipeline: an edge triggered latch is used at the entrance and exit from the IsoChannel itself, resulting in three pipeline

phases.



Within a Cell Period, three enable signals are used to sequence the pipelined data transfer over IsoChannel. TENA is used the IsoChannel :Talker: to enable 24 waves of two-byte-wide data at each clock edge, which are latched at REG T. The zeroeth data wave is valid on the input to the IsoChannel latch at the onset of the enable signal and changes with the first clock edge.

IENA is used to enable latching at the listener board, REG L, one clock later. Finally LENA is used by the listener to provide 24 timeframes to write REG L data to the onboard destination.



QBUS Interface to Host

ICSRAMS are individually loaded by the host. The RAMs are memory mapped to the host address space and located at offset

0x40000 from the base address of the board (addresses 40000 to 4228f). QBUS is a local bus used to distribute host bus signals to the IsoChannel control block as well as other board resources. QBUS timing is shown on Dwg. CBM-T-101; QBUS signals are described below.

QD00..7 I/O A bidirectional eight bit local data bus.

QA00..15 I Sixteen bit local address bus.

QMEMRD* I Active low signal used to gate the read data onto the data bus.

QMEMWRT* I Active low write enable signal.

QALE I Active high pulse used to latch an incoming address

QCHWAIT* O Open collector signal driven by IsoChannel logic (and other board logic) to extend the cycle time.

ISOCS* I A decode of the high order QAnn address bits. Directs the memory operation to the IsoChannel devices.

ISOINTR* I IsoChannel interrupt request for service. Use an open collector driver. If there is more than one reason to interrupt, provide a status register which can be read and written by the host using ISOCS2*

ISOCS2* I A second decode of the high order QAnn address bits. If other control pulses or status registers need to be implemented they are mapped to address space 48000 thru 4800f.

APPENDIX B**1. SCOPE****1.1 Introduction**

The recent introduction of suitable operational standards, sophisticated application of specific integrated circuits, and the potential of common carrier implementation of long distance high speed constant bit services in accordance with the standards has enabled an opportunity for high quality video networking. One of the necessary components to exploit this opportunity is a DATA-FLOW (MediaNet(tm)) architecture to enable end to end (terminal to terminal) and server to terminal constant bit rate services. CBM Inc. has a family of products to implement this architecture. One of the primary functions necessary for proper functioning of a data-flow system is a method for generating and terminating audio and video information. This functionality is embodied in the CBM Inc. MNAV1mc audio/video board.

1.2 MNAV1mc

The CBM Inc. MNAV1mc is a Micro-Channel compatible audio/video display/capture board with an isochronous bus connection to allow constant bit rate services to be used for the purpose of capturing and transmitting real time audio and video as well as receiving the audio and video.

The MNAV1mc supports capture of PAL or NTSC video and conversion to YUV 4,4,1 for transmission over the IsoChannel(tm) to the network board for connection to the outside world. IsoChannel is part of CBM's data flow architecture allowing for data to flow constantly and smoothly to or from terminals, servers, switches, or bridges.

The MNAV1mc supports capture of audio in two forms. One is telephone quality digital audio in uLaw or Alaw standards. The other form is AES (Audio Engineers Society) digital stereo.

The MNAV1mc supports the display of real time video from the network or from local sources.

The MNAV1mc supports the regeneration of digital audio from the network in both forms. The MNAV1mc operates in concert with Windows 3.1 and proprietary CBM software to implement a smoothly functioning operator interface for connection to video conferencing, video data bases, security systems, retail sale or other information kiosks, as well as applications encompassing mutual document editing, and Vmail.

2. Functional description

The CBM Inc. MNAV1mc is a PCB assembly that interfaces IsoChannel (tm) to analog video and audio I/O. The data present on the IsoChannel is comprised of time slots. The slots are carrying video, audio, or other constant bandwidth signals. In control terms, the MNAV1mc is a device that is setup by external signaling from the host bus. After initialization and setup, the MNAV1mc accepts the slots and converts them to the appropriate analog form and accepts analog

1 input and formats them into slots cells and transmits them on the IsoChannel bus.

2 The analog side of the board interfaces to video and audio connections. The video is PAL/NTSC
3 composite analog video and the audio interface is single channel voice grade analog or AES stereo.

4 The Micro Channel host bus interface provides power and a data path for setting and reading board
5 parameters as well as still frame capture interface.

6 The IsoChannel interface is responsible for maintaining synchronization with the bus,
7 receiving control information from the host bus, receiving data on its assigned slots, and sending
8 data on its assigned transmit slots. The MNAV1mc uses BTL transceivers for the line electrical
9 interface. All transactions are as assigned by the controlling software. Local display of captured
10 data can be done by setting slot assignments on the IsoChannel to transmit and receive on the same
11 time slots.

12 2.1 IsoChannel interface

13 The IsoChannel interface is a slotted time domain multiplexed data bus designed specifically
14 for transport of constant bit rate services to and from network and audio/video subsystems. The
15 IsoChannel is implemented using FPGA technology to CBM's functional specification. The
16 IsoChannel is a 16 bit wide bus at a basic clock rate of 38.88 MHz. The IsoChannel is divided
17 into 169 frames or zones per second. Each frame is further divided into 8848 slots (plus a spare
18 11 clocks at frame time). The signals on the bus are the 16 data lines, the 38.88 MHz clock, and a
19 frame clock, and a payload signal. It is required that any IsoChannel device be capable of
20 providing the clock, however only one is chosen in an IsoChannel equipped system to do so. The
21 payload signal is driven by whichever device is assigned the transmit function in a given slot.

22 The host computer has the responsibility of controlling the operation of the IsoChannel. The
23 control of the IsoChannel is accomplished by loading a ram whose operation is synchronized and
24 mapped to the IsoChannel slots. IsoChannel traffic is governed by the schedule of isochronous cell
25 traffic at the IsoChannel. One slot period at the IsoChannel consists of 26 clocks. 24 clocks are
26 used to transfer cell data two bytes wide and two clock times are used for overhead. Each cell
27 time is associated with one of 64 isochronous users, identified by a six bit wide user ID field in the
28 control ram. In addition two bits in each byte of the control ram are devoted to read or write
29 commands to/from the bus in conjunction with each user ID field. The ram uses 8848 locations
30 for correspondence to the slots on IsoChannel. The IsoChannel is flexible by virtue of the ability
31 to be programmed on a slot by slot basis and places data onto the bus by programmable data
32 density instructions from the host. Instructions are static in nature, that is instructions are held and
33 executed continuously until changed by the host. In addition the IsoChannel provides FIFO
34 buffering for output data streams.

2.2 Video function

The video functions on the MNAV1mc are display of video from the IsoChannel or from a local source, and capture of video data from a camera or other analog video source in PAL or NTSC format.

2.2.1 Input video processing (From IsoChannel bus)

The video flow from the IsoChannel is first processed in an FPGA to put it in a form acceptable to conventional and proven video circuitry. The balance of the video data stream going to the display is processed by a Chips & Technologies windowing engine and overlay buffer control chip set (69003/69004) operating in conjunction with Philips color space converter (SAA7182). The balance of the circuitry is video ram for buffering purposes and a Brooktree ramdac (BT121). The input video processing circuitry has the following properties: Expands video data stream (adds non displayed samples); provides expansion of CIF data; marries an incoming video stream to the graphics subsystem of a computer by interlacing with the graphics controller; provides scan rate conversion and windowing control for display of a live video image on a computer graphics monitor; accepts YUV 4,1,1 PAL or NTSC digital video data; RGB 16, 24, 32 bit output; controls window position by X-Y coordinates; independent X-Y scaling of video Image to as small as 1/8 original Image size; interlaced or non-interlaced video; output resolutions up to 1024x768; still frame capture supported; converts the buffered RGB data to analog data; switches data streams from video to graphics per the input video processor; provides frame buffering for the incoming video data stream which is coordinated with the graphics subsystem via the video processor working in conjunction D/A converter and analog switch.

2.2.2 Output video function (To IsoChannel bus)

The Capture video function is implemented using Philips A/D chroma and luminance A/D converters (TDA8709/TDA8708) in association with a video multi-standard decoder (SAA7151). This combination captures and converts PAL or NTSC analog data to and luminance data to YUV 4,1,1. Further processing is implemented in FPGA technology for the purposes of concatenating data, (removes non displayed samples) and decimating data for CIF resolution if necessary.

2.3 Audio subsystems (CODEC)

With the exception of encapsulation of data and the unloading of data from IsoChannel, the audio subsystem is primarily the responsibility a single IC (Analog Devices AD1849). This device contains everything needed for both AES stereo and monaural companding of audio information. The features implemented on the MNAV1mc are as follows: frame synchronization of AES data stream, data field decode for host examination, sigma/delta D/A conversion, programmable mute function, stereo and mono audio line outputs, line and microphone inputs, programmable gain, sigma/delta A/D conversion, monitor function, converts analog audio data to an ALAW or uLAW POTS digital data streams; converts POTS digital data stream to analog audio.

Some support for the AD1849 is built into the FPGA for encoding the data for transport by the IsoChannel. These are frame synchronization of AES data stream for proper decoding and data field encapsulation and framing for IsoChannel transport.

2.4 Host bus interface

The MNAV1mc host bus is a MicroChannel (tm) compatible interface which provides the interface to the host CPU for control and status data interchange for each of the features available on the board.

2.5 Mechanical description

The MNAV1mc conforms with the mechanical standards for MicroChannel. The connections for audio and video are a 26 pin "D" and have the pin assignments as follows:

<u>Signal</u>	<u>Pin#</u>
video in (signal)	8
video in (return)	17
audio line out left (signal)	4
audio line out left (return)	13
audio line out right (signal)	5
audio line out right (return)	14
audio line in left (signal)	2
audio line in left (return)	11
audio line in right (signal)	3
audio line in right (return)	12
audio mono out (signal)	6
audio mono out (return)	15
audio mic in left (signal)	1
audio mic in left (return)	10
audio mic in right (signal)	7
audio mic in right (return)	17
chassis gnd	24
NC	9,16,18-23,25,26

The connections for VGA are implemented in a 15 pin "D" connector and has the following pin assignments:

<u>Signal</u>	<u>Pin#</u>
Red video	1
Green video	2
Blue video	3
NC	4,9,11,12,15
Digital return	5

27

1	red return	6
2	Green return	7
3	Blue return	8
4	Digital return	10
5	H-sync	13
6	V-sync	14

7

8 3.0 Network Video format Overview

9 The low speed (155.52 Mbs) Medianet connection is limited to 149.56 Mbs for data
 10 transport and any video format must be less than or equal to this value including ATM cell
 11 overhead. By using YUV 4:1:1 the network bandwidth requirements for uncompressed video
 12 transport will be as follows*:

13	720X590X25 (PAL)	127.44	Mbs
14	720X483X30 (NTSC)	125.1936	Mbs
15	352X28 (CIF)	36.49536	Mbs

16 *note: these values do not include the ATM cell overhead and are stripped of non displayed pixels.

17

18 The video data is stripped of samples that are not included in actual display of data and sync
 19 information is encoded by value. A byte that is equal to zero is a horizontal sync, two bytes of
 20 zero is a vertical sync, and three bytes is vertical sync/frame tag. Immediately after detecting a
 21 frame tag, the following four bytes of the video data are the frame number which is used for
 22 generating an interrupt on value or else the count can be accessed at any time by the host bus. In
 23 addition, the frame number can be initialized to any value, be set to increment or decrement, and
 24 the interrupt can have different logical relationships (\leq , \geq , $=$). The front and back porch
 25 timing is not transmitted and is reconstructed locally. The number of ATM cells that are sent per
 26 video frame are adjusted so they can distribute in a regular manner onto the IsoChannel. It is the
 27 function of an FPGA on the MNAV1mc to translate MediaNet data formats to and from
 28 conventional data forms.

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APPENDIX C

1. The Emerging Multimedia Computing Environment

A few years ago, Alan Kay provided the author a tour of Xerox's Palo Alto Research Center. The things being done there with computers were a revelation. The interaction of 11-year olds with the computer was being studied by a psychologist; the children had designed their own icons for the graphics-oriented system they were working with. While Kay played Bach on an organ console, his program captured the music on a monitor screen. Kay edited his with a mouse, and the system played the new version back, complete with organ-pipe turnon transients. This computer and the others were tied together with shared cable system, but almost as an afterthought; how people interacted with computers was more important than how computers interacted with each other.

By now the use of graphical interfaces with icons has become commonplace, as has interconnecting systems with Ethernet. The interface between the user and the computer has progressed from a one-dimensional folded character stream to a two-dimensional page or desktop metaphor. The use of local area networks has made it possible for small, cheap, computers to take over much of the work of mainframes. these innovations arising from PARC and similar places have now been assimilated into the mainstream; Microsoft's Windows has moved from a clumsy imitation of the Macintosh to a must have item for serious PC users. Where will our next revelation come from.

In answering that question, consider that we live in a 4-dimensional world, with time as the fourth dimension, and thus far only two spatial dimensions have been routinely used in computer interfaces. It now appears clear that the next major step forward is to make use of the time dimension. This means going from still frames to video and other moving images, and from simple beeps to audio capabilities rivaling Kay's work of the seventies.

The third space dimension will be honored mainly by being simulated in two dimensions for applications such as mechanical design. Computation may be done in three dimensions, but the human interaction will still assume a flat canvas. True three-dimensional output media, such as holograms, are still a large distance on the horizon.

In going to a computing environment that takes advantage of the time domain, the best description is multimedia. The demands of video and audio are substantially different from current data transfer applications and will require new hardware in three major areas:

On the desktop

The network

The multimedia server

A company that intends to work in multimedia computing must make sure that all three of these bases are covered, either itself or by partners it works with.

This situation is similar to the one that existed in the early fifties with color television. No one would want to buy a color set if there were no programs being broadcast in color, and no

1 station would invest in color equipment without an audience to justify it. Fortunately RCA both
2 manufactured sets and owned broadcasting stations; it subsidized both sides until the market
3 reached a self-supporting size, at which point it had a substantial lead over its competitors.

4 Timing is also a critical element. There is little room for a startup if major firms already
5 dominate the market, but success is equally elusive if one is too early. The fate of the early work
6 is well known.

8 1.1 CBM in the Emerging Market

9 CBM is addressing the three hardware areas mentioned above: the desktop, the network,
10 and the server. It is positioned to achieve the necessary critical mass: in each of them it will have
11 products that will work together well and also provide an open system in which users can attach
12 other equipment and applications. Users now demand standards-based systems that will allow
13 other vendors' machines to attach the networks, and will permit a wide variety of applications to
14 access the information coming in over the network.

15 The timing is right. Video-compression technology is making rapid strides, leading edge
16 applications are in sight, and multiservice networks are emerging from standards committees, with
17 serious plans being made to implement them as public facilities. In order to get the users a little be
18 pregnant Apple is now including software-only video decompression program called Quicktime in
19 the Mac operating system, and is encouraging the development of hardware enhancements for it.

20 Video compression until now has largely been a proprietary field, with users required to buy
21 matched pairs of compression/decompression boxes from the same vendor. Now standards are
22 catching up with the technology from several directions, and it is important to be able to claim
23 standards compliance, although *which* standard is still a matter of choice. JPEG (Joint Picture
24 Editing Group), CCITT, or the de-facto Intel/IBM DVI (Digital Video Interactive) standard
25 developed for games. A system that supports whatever the customer needs, or thinks he needs, is
26 the right answer.

28 1.2 CBM Experience: the Berkomp connection

29 The country that has been most aggressive in pushing for high-speed public networking has
30 been Germany. A number of trial networks operating up to 155 Mbs have been set up over the
31 last few years. One such project, Berkomp (for Berliner Kommunikationssystem), provided
32 experience in high-speed networking for CBM's original parent, Condatec. This technology is
33 now available to CBM.

34 For Berkomp, Condatec developed components of a multimedia network: audio, video, and
35 graphics boards for PCs, as well as network interfaces supporting early versions of Broadband
36 ISDN at 139 and 153 Mbs. The experience gained by the Bundespost in operating a variety of
37 applications and services over the trial network has provided CBM with insight into the potential of
38 such system. This insight goes well beyond that shown by most networking companies, small or
39 large, and should be considered one of the firm's greatest strengths.

1.3 Product areas

This section will cover specific CBM products, with reference to the overall needs of the multimedia systems.

1.3.1 Desktop interfaces

Since there are several desktop families in common use, covering the market adequately involves providing boards for all of them. The PC, the Macintosh, and the Unix-based systems such as Sun will all have to be covered in order to provide for existing desktops. There are tens of millions of PC's and other desktop computers installed in this country. It would be totally impractical to require users to discard them in order to phase in new multimedia applications.

CBM has boards with common functionality designed for the most popular computer buses:

AT bus and MCA bus for IBM compatibles

Nubus for Macintosh II

S-bus for the Sun SPARC family.

These boards differ in their interface to the computer's system bus but otherwise provide common functionality and common types of connection to the network. Data passing from board to board, for example from the network board to the video board, bypasses the system bus and uses CBM's own IsoChannel.

This approach makes a great deal of sense. It offloads the computer's system bus, which might otherwise be totally clogged by the data volume required by full-motion video. It also provides additional commonality between the board designs used in the various hardware platforms, which otherwise differ in the way they transfer data over the system bus.

Software is a very tricky issue for networks whose operation affects all parts of the computer, with file transfer, audio, and video being routed to the monitor. Particularly in the PC with DOS, the normal rigid boundaries between applications, operating system, and device drivers were never developed. As a result, applications have had to know far too much about the devices on the system. If one is to introduce a new device, it must somehow take advantage of standard APIs (Application Program Interfaces), since old programs have no way of accommodating new drivers.

Other operating systems, such as Unix of the Macintosh operating system, have more sophisticated facilities but nevertheless have quirks that are not easy to work around.

These problems have received a great deal of attention at CBM. Without the benefit of exhaustive experience, it would be difficult to say if all the potential problems have been solved, but it is clear that there is an adequate level of expertise to deal with any problems that could come up.

1.3.2 The server

Most companies interested in developing multimedia systems assume that the source of the

1 information is somewhere else. Generating the video, performing the calculation for visualization,
2 and sourcing complex audio signals are all someone else's problem. This is a bit like the sound of
3 one hand clapping: interesting to contemplate, but difficult to find an application for. CBM, in
4 contrast, has tackled the server problem and made it central to its strategy.

5 The information volume that can be absorbed by video workstations is enormous. There is
6 little likelihood that it will be possible to generate everything on the fly; data, video segments, and
7 an enormous variety of material will need to be summoned up from storage media and sent via the
8 network to the multimedia workstation.

9 The server needs a great deal of versatility in its architecture since the applications are quite
10 varied and subject to change as more applications are conceived fro multimedia systems.
11 Examples of the storage media that users may need include:

12 laser video disc
13 music CD
14 CD ROM
15 digital audio tape
16 video tape (in a large variety of formats)
17 conventional computer disc
18 optical read/write disc
19 paper document plus scanner
20 as well as other high-volume sources such as
21 video camera
22 radar receiver
23 instrument output

24 CBM has recognized this issue in making the server central to the architecture. Its MDDBS/1
25 provides a variety of inputs switchable to the network output. This system should be able to retain
26 its flexibility and be able to handle new media as they come along.

27 28 1.3.3 Source Switching

29 With a wide variety of source media and multiple destinations, some sort of switching is
30 required to get the data to the proper end point. CBM allows for this in having a central ATM
31 switch at the heart of the network, in fact as an integral part of the multimedia server.

32 An ATM switch can in fact be a number of different things. The basic idea is simply that
33 the unit of data switched is a fixed-length packet or "cell" in the telephone world. The multimedia
34 capability of such switches follows from the fact that the small cells can be interleaved easily on
35 any communication line ranging from voice-grade up to gigabits per second. This allows fixed-
36 and variable-bandwidth services to coexists comfortably on the same network.

37 Any shared medium network or shared memory can act as a switch. Units of data (in this
38 case cells) are brought into memory from one port and are read out to another. The shared
39 medium network (which can include anything from a mutidrop wide are network down to the

backplane of a computer) accepts data from one node, addressed to another. Of these two methods, the shared memory is probably the easiest and cheapest to implement, although when the number of ports on the memory becomes high, access logic for the memory beings to looks like a shared bus.

1.3.4 Premises distribution

The common denominator of all the options used by CBM in switching and distribution (both on the premises and off) is the use of ATM cells. Differing switch technologies can be used, and different collection and distribution networks can be installed, but information source and destination can be insulated from the differences.

For example, the distribution of ATM cells on the premises can be either point-to-point or via an 802.6 network.

The cell formats for these two networks are very similar. For public networks, 802.6-based feeder networks will hand over their cells to ATM switches, which will be capable of handling very large volumes totaling hundreds of gigabits per second in the aggregate. In premises networks, this compatibility means that CBM will be able to make use of both technologies.

The point-to-point network is relatively simple: for each fiber, one end transmits cells at will, and the other end receives them. The ultimate destination of each cell may actually be different, but the link has only two nodes and avoids the need for a medium-access protocol required with shared media such as Ethernet.

CBM has provided a cost-effective point-to-point network adapter in its BFA/1, which uses the cell formats emerging from the Broadband ISDN standardization effort. When B-ISDN is installed in a public network, the BFA/1 will be usable for off-premises networking as well as on-premises.

The other alternatives, the IEEE 802.6 protocol, was designed to support multimedia applications over distances of tens of miles, but it still work very well for premises applications. It is a shared-medium network with a medium-access protocol that is distance-insensitive compared to LANs. It also is cell-based, with a cell size and structure designed to be compatible with wide-area networks based on ATM switching.

The use of a shared network has its pros and cons relative to the ATM switch and dedicated links. The positive side is that a switch is not needed at all since the cells can be addressed directly to any destination on the network. Further, no single point of failure exists; if any node fails, the network automatically reconfigure itself.

The limitation is in the total throughput available. Chips will shortly appear on the market capable of running the protocol at a speed of 45 Mbps, but higher SONET speeds such as 155 and 622 Mbps are still a couple of years away. Since the 802.6 network is bidirectional, the 45 Mbps speed gives a total of 90 Mbps for all the users on the system, but that is not sufficient to support uncompressed video.

A compromise solution proposed by CBM makes sense. It involves using 802.6 as a

multimedia network for modest size workgroups, with the groups interconnected via a point-to-point links from a bridges to an ATM switch. The BFA/1-based link can run at high speed to retrieve data from the server or from the outside world, with distribution to the desktop via the shared-medium 802.6 network. This solution will work so long as the bandwidth demands are moderate; it has the advantage of sharing the medium among a number of workstations. Any workstation which requires continuously high rates, as for example, in uncompressed or lightly compressed video, can be connected directly to the switch.

1.3.5 Off-premises networking

Premises networking is of course only part of the requirement. High-speed networking facilities are now being planned by the telephone companies, with actual service beginning in 1992. The service is SMDS, which is based on the IEEE 802.6 standard with some simplification and some additions. While the 802.6 technology is not efficient for users distributed uniformly over hundreds of miles, as employed by SMDS it will work very well.

SMDS will use 802.6 as the protocol between the customer premises and the central office. In order to provide privacy, the connection for particular subscriber will not pass through anyone else's premises; multiple connections to the bus are permitted, but they will all be within the same customer's facilities. Connections between central offices may or may not use the 802.6 protocol (eventually they will be Broadband ISDN with large ATM switches) but the users will not be aware of the difference.

The additions made to the 802.6 standard include the screening of source and destination addresses and the incorporation of billing facilities. The capability of multiple premises connections at the T1 speed is not required, making the link in effect point-to-point. In this case the distributed queue protocol need not really be implemented, but the format of the fields in the cells sent down the line must be the same as when multiple connections share the bus.

SMDS currently provides only for data transmission, with a connectionless service consistent with that provided by LANs. This is not ideal for multiservice facilities, but the 802.6 protocol will accommodate the other services (drafts are being written now in the IEEE committee) and SMDS can be upgraded to handle them. There is a natural reluctance on the part of the telephone industry to compete with existing POTS for voice, but the economics indicate that carrying voice from premises to CO on the 802.6 link make a lot of sense. If the RBOCs don't do it, the alternative carriers will.

Variable-bit-rate services, on the other hand are new and not cross-elastic with existing revenue sources. As a result, there should be little reluctance on the part of the carriers to adopt such features, provided existing equipment can be upgraded economically to support it.

The keys to the adoption of SMDS are the provision of cost-effective tariffs, the availability of CPE facilities, and the installation of switches in a sufficient set of central offices.

Present estimates are that Bell Atlantic will offer service late in 1991 to selected customers on a special-quote basis, with the tariffed service coming on-stream in the spring of 1992.

1 Pacific Bell will probably be the second of the RBOCs to offer the service; their field trial
2 started with Stanford University and wound up with a number of name Silicon Valley firms such as
3 Apple and Hewlett-Packard.

4 5 1.3.5.1 Until SMDS arrives

6 With the telephone industry ramps up SMDS, other alternatives are available for the short
7 run. These include the old standby of leased lines, an expensive solution if there are many sites to
8 be interconnected, but reasonable if there are only a few. The jump in capacity between T1 at
9 1.544 Mbps and T3 at 44.7 Mbps is a very large one; however, fractional T3 may become
10 available in some cases.

11 Another short-term solution is frame relay. Frame relay service is ramping up faster than
12 SMDS, but it is limited to T1 speed. The usage-sensitive feature of frame relay is a big benefit for
13 slower applications, but multiservice applications will be at the high end of the T1
14 range, not the low end. Eventually frame relay will migrate to T3, but SMDS may well arrive
15 first and provide the general connectivity that frame relay, with its permanent virtual circuits,
16 cannot match.

17 A dark horse for interconnecting multiservice sites is primary-rate ISDN. The acceptance of
18 ISDN in the US has been so slow that it would be risky to count on basic-rate ISDN, let alone
19 primary rate ISDN, in most parts of the country in the next few years. The market failures of
20 ISDN have convinced most of the players to wait for a new roll of the dice -- some looking at
21 frame relay and some at SMDS.

22 23 2. Gating technologies

24 The advent of multiservice networks will be the result of a number of technical factors, all
25 of which seem to be at the right point either now or in the immediate future.

26 27 2.1 Video compression

28 The video compression business has accelerated rapidly in the last few years. Having lived
29 for perhaps a decade on the long-distance video conferencing application, this industry has
30 received a shot in the arm from the approach of HDTV. The desirability of having a digital TV
31 system, coupled with the 30 MHz bandwidth of HDTV, has made compression a must if
32 conventional 6 MHz channels are to be used. Also, the distribution of video entertainment over
33 digital fiber lines also depends on the use of compression.

34 The result is that a variety of standards and approaches are reaching fruition in different
35 areas. The JPEG (Joint Picture Editing Group) started from the point of encoding still frames,
36 while the DVI consortium (principally Intel IBM) started from video game technology. CCITT,
37 representing the telephone industry, of course is doing its own thing.

38 Whichever approach becomes the most popular, the result is that the manufacturing volumes
39 and integration in silicon will force prices down to a few hundred dollars per terminal within a few

1 years. This will make it possible to run the desktop computer with video capability at a price that
2 hundreds of thousands of users will sign up for over the decade.

3 4 **2.2 High speed microprocessors**

5 The horsepower race in microprocessors is no more than a year away from the 100 MIPS
6 level, an astonishing level of power when compared with the original VAX at 1 MIPS, which was
7 capable of supporting two dozen time sharing users.

8 If a 1 MIPS can do a respectable job of word processing or running a spreadsheet, what can
9 be done with 100 MIPS? Manipulation of pixels, video and audio synthesis, complex
10 communication protocols, all can be done in the processor's spare time. Certainly attachment to a
11 multiservice network will not result in the processor being swamped.

12 Concurrently, the speeds as well as the sizes of memory chips have been increasing.
13 DRAMs, the main memory element in most desktop machines, are widely available under 60
14 nanoseconds cycle time, with 4 megabit capacity. Likewise, the SRAM chips used in the fastest
15 memories or caches, have dropped substantially in price for a give speed. The result is that the
16 cost of building memories for visually-oriented data is not an inhibiting factor.

17 18 **2.3 Multiservice networks**

19 The final enabling technology is in the networking area. The last decade has seen a strong
20 march toward standards on the part of the user community, with the result that a nonstandard
21 network is a very difficult sell. Users would prefer to wait for something that is at least plausibly
22 a standard, even if it means delaying their implementation plans.

23 The key to providing networks that work well with different kinds of traffic is to divide the
24 data streams into small segments or cells that can be readily intermixed. This has been the main
25 consideration that has led 802.6 metropolitan networking standard to the use of cells. For this
26 reason and also because of the potential cost and speed advantages of ATM switches, the wide area
27 networking world is also headed toward a cell orientation.

28 Taking the cell approach to the desktop then brings the multiservice advantage to the LAN
29 user. In addition, it provides a consistent approach to networking, with essentially seamless
30 boundaries between local, metropolitan/campus, and wide area networks. This latter advantage
31 will make the cell-to-the-desktop approach advantageous even to the conventional data networking
32 user, whose major application is simply the transfer of data files.

33 The result can be simplification of the networking process, where the incompatibilities of the
34 various networking layers (TCP/IP, ISO, SNA, DECnet, etc.) can be circumvented. The use of a
35 global E.164 address with geographic significance (it is essentially a telephone number) will bring
36 to computer networking the advantages that the telephone industry has had in country codes, area
37 codes, etc., and the post office has had in zip codes. No switch will have to know much more
38 than its immediate environment to be able to route data worldwide.

39 The 802.6 protocol has been designed to handle connectionless data, isochronous traffic

1 (fixed bit rate), and variable bit rate traffic consistent with the needs of compressed video. In
2 order to meet the time constraints of the SMDS introduction, the 802.6 standard was issued with
3 coverage only for connectionless data. All other items were left for future; work is now under
4 way on them.

5 The remaining two services are now being finished. Most of the significant decisions in the
6 isochronous case have been made: the cells will be dedicated to a single connection rather than
7 being shared between many connections, as originally envisioned. Such cells will be directly
8 compatible with ATM switching. The mechanism for supporting the generation of cells at a
9 variety of fixed bit rates has been largely defined: the only complication is the transport of 1.544
10 Mbps T1 traffic, which does not fit the pattern of $N \times 64$ kilobits per second.

11 The mechanism for supporting variable bit rate service has been proposed and refined
12 several times. It is likely that all the significant decisions will be made within the next four
13 months.

14 The result of this schedule is that it will be possible to start immediately on the development
15 of hardware that implements all the 802.6 services. If some changes are made as the standard goes
16 through the approval process, the designs can be updated before final commitment to production
17 silicon.

18 In the short run, the lack of high-speed 802.6 or ATM-oriented silicon can present a
19 problem. At T1 speed, there is no need to go to VLSI implementation; FPGA chips programmed
20 in-house are the solution being adopted in most places. The key to cost-effective implementation
21 at high speeds is the availability of commercial chips. Small 802.6 networks have been built
22 without VLSI, but the costs will deter widespread implementation. Chips running at 45 Mbps will
23 be available in 1992, but it is not clear whether sufficient features will be available. Custom
24 ASICs are probably the best answer; new tools make this an increasingly viable option for modest
25 production runs.

26 3. Competing technologies

27 The idea of a distributed, video-oriented computer system is a new one in the market, but
28 one that appears inevitable due to the convergence of the various technical and market forces
29 mentioned earlier.

30 The three components, source, networking, and desktop, must all be handled skillfully and
31 cost-effectively for the company to succeed. If any one is perceived as inadequate, the other two
32 will fail to sell also. Therefore we need to review the other alternatives, the roads not taken, to be
33 assured that the marketplace will not go in another direction. Or if it might do so, we should be
34 assured that product changes are feasible.

35 The computing scene in all respects is sufficiently complicated that there is a great benefit
36 for people to do the same thing as their neighbors are doing, even if they are not networked
37 together. The comfort level associated with being able to compare notes with someone else drives
38 customers to opt for the same thing that is already in common use, if it will serve their needs. For
39

1 this reason it is very hard for a new product, even if full of new features, to achieve dominance if
2 an existing product is most people's default choice. The success of Microsoft DOS, Lotus 1-2-3,
3 or the HP laser printers are cases in point.

4 In new areas, however, there is no default choice, and the field is open to new players.
5 Skill in picking the right technical choices, and enough elbow room to do midcourse corrections,
6 make the difference between the startup that succeeds and the one that fails.
7

8 3.1 Desktop alternatives

9 The variables at this point on the product spectrum are mainly the platforms supported and
10 the type of video compression used. By supporting most of the common desktop machines,
11 including the AT bus and the MCA bus for the PC, the Nubus for the Mac, and S-bus for Sun
12 SPARC, most of the important machines are covered.

13 Adding support for another make of computer would not be a difficult operation; simply
14 adapting the existing logic to a different system bus, but keeping the IsoChannel and the external
15 connection the same.

16 The evolution of the video compression technology is likely to continue for some time. The
17 various standards may coalesce in time, but the technology is sufficiently immature that new
18 methods may arrive on the scene at any time. The only way to handle this will be to redesign to
19 video compression/decompression section of the board, but preserving the external connections to
20 the network, the system bus, and the IsoChannel.
21

22 3.2 Server alternatives

23 This situation is perhaps the easiest of the three in terms of the upgrade or redirection issues
24 concerned. Once the architecture of the server is established, addressing new media is a matter of
25 designing new boards to accommodate the hardware. The physical drive hardware to support new
26 media will come from outside sources, and the development required is to adapt the data format
27 native to that medium to the networking requirements of the CBM system. For example, a
28 read/write laser disc player might require a new adapter board utilizing components from a read-
29 only laser disc board. Partnership relations with companies promoting new media will clearly be a
30 possibility.
31

32 3.3 Networking alternatives

33 This is the most critical area. Users will not install a multiplicity of networks to serve
34 different applications. They need to feel confident that they will be able to attach the equipment
35 from a variety of vendors to their networks, and hence insist on standards-based nets. The
36 network technology of choice must both meet the needs defined by the application (which a
37 proprietary design could do also) and also have broad acceptance in the field.

38 High speed networks are relatively new, but there do exist a number of alternatives to be
39 examined as possible paths.

3.3.1 FDDI

FDDI has been designed as a data network, specifically as a primary network rather than as a backbone. It provides packet transport at 100 megabits per second with a protocol taken from the IEEE 802.5 token-passing ring. It has made a few changes; one for the better is relocking at each node, which avoids the jitter problems currently plaguing large token ring installations. As a backbone rather than primary network, FDDI has problems with transparent bridging because of ring stripping and acknowledgment bit issued. Some vendors (such as Motorola and National) have diverged from the standard in these areas.

However, FDDI has not been designed to handle any traffic other than packet data from computers. For large networks the latency problem is an issue; even if the load is light, one must wait until the token arrives before initiating transmission. Sending video over FDDI would subject it to uncertain delays, very likely exceeding the requirements of adequate picture quality. The same issue also affects voice and high-quality audio, which is in fact less tolerant of transmission glitches than video.

On the positive side, FDDI has been espoused fully by the computer industry, and there is no shortage of network products that use it.

3.3.2 FDDI - II

FDDI-II is the FDDI world's attempt at a multiservice network, one that has shown no signs of success yet. It has the fatal flaw of being incompatible with FDDI; the two versions cannot share the same fiber. As a result, FDDI's success mitigates against the adoption of FDDI-II.

The multiservice capability of FDDI-II is limited. It provides isochronous channels of 6 Mbps (up to 16 of them), which must be subdivided externally for applications such as voice that work in terms of smaller channels. No variable bit rate capability other than the connectionless packets is available.

While the situation may eventually change, the adoption of FDDI-II is currently close to nil. Some silicon vendors are leaving hooks for it in their newer chips, but the market demand has not yet to materialize. (In fact, the FDDI demand has not reached expectations, as the problems of vendors like In-Net demonstrate.)

3.3.3 Frame relay

Frame relay has achieved a great success within the past year, at least as far as publicity is concerned. In a sense it is ISDN in disguise, with the LAP-D packet format slightly modified. It has the advantage in the internetworking field of requiring no hardware changes, unlike SMDS. This makes it an excellent target for opportunity for private network suppliers and vendors like Northern Telecom, whose SL-100 switches can support it.

Like FDDI, frame relay is designed to support data only. Currently it is limited to 2 megabits per second by the standards, and to permanent virtual circuits by all the current

1 implementations, but it is possible that these factors may change.

2 The major weakness long-term is that frame relay is not strategic for the carriers. They
3 seem to be unanimous in the view that a cell-based strategy holds the best long-term prospects for
4 them. Despite the recent publicity for frame relay, they do not have the money to support two
5 new generations of switching equipment. If they support frame relay, most of them will do it by
6 converting to cells transmitted over SMDS or Broadband ISDN.

7 8 **3.3.4 Circuit switching**

9 Like neo-Victorian architecture, something we had bid goodbye to is back. For gigabit
10 streams, it makes some sense. The limit to network speeds in such cases is the protocol
11 processing, and with circuit switching there is less protocol processing per megabyte of data
12 transmitted than there is with packet switching (such as frame relay) or cell switching (such as
13 802.6 or ATM). Therefore for the very highest rates, cell switching may be the method of choice,
14 as in doing a brain dump of a Cray.

15 But the playing field is leveled somewhat by the breakthroughs represented by banyan
16 switches. When they come into widespread use, they will be able to handle multiple gigabit
17 streams, although the costs will be prohibitive for most premises installations.

18 19 **3.3.5 IEEE 802.9**

20 The 802.9 committee is the PBX manufacturers' toehold in the 802 standards structure. Its
21 charter is to provide integrated voice and data access to a LAN. The committee started by
22 reinventing ISDN at 4 megabit instead of 1.5; the results in the market place will be predictable.

23 As an encore, they are working on a "high-speed" version that will run over twisted pair
24 from a desktop to a concentrator at 20 megabits per second. This represents the upper speed
25 boundary of IEEE Project 802's charter (the 802.6 MAN group got an exemption), but in the face
26 of 100-megabit FDDI over twisted pair, it is not likely to turn many heads.

27 For several years, the 802.6 committee has been proposing that 802.9 work on a compatible
28 system, with the cells from an 802.6 backbone going over twisted pair to the desktop, but so far to
29 no avail.

30 31 **3.3.6 Experimental systems**

32 Often technology is developed and publicized in research laboratories, but is never actively
33 pushed as a commercial offering. A recent case in point is the H-bus developed at Bellcore for the
34 customer-premises end of a Broadband ISDN link.

35 This design, like a large number of others done in Bellcore and Bell Laboratories, is a
36 demonstration item. Bellcore in fact feeds technology to the telephone industry through standards
37 organizations; its work in SMDS/IEEE 802.6 and Broadband ISDN are cases in point. Other
38 items of proprietary technology could presumably be licensed by third parties and manufactured,
39 but there is no history of this having happened in the network field.

4.0 Summary

The computer industry is now on the verge of a major change in the human-computer interaction; the incorporation of moving images into the desktop machine.

This movement is far enough along that we can say with confidence that it is occurring, but new enough to be wide open in terms of market opportunity. The critical technologies are sufficiently well developed to support viable applications.

CBM is addressing the three key elements in video-based distributed computing; the desktop, the network, and the server. Its current plans show it has the vision to understand the opportunity that currently exists for a comprehensive set of products.

The underlying technologies that are required for the implementation of multimedia networks are well understood. Components are available now, with the exception of high-speed implementation of 802.6 and perhaps the more advanced video compression algorithms. However these items are not required immediately; they should be available in ample time for CBM's plans.

From a technology standpoint, CBM's architecture and implementation decisions have been both forward-looking and well thought out. They should have a very successful future.

In the claims:

1. A multimedia network system for operation in conjunction with a computer and a data network, comprising:

a high speed data bus;

a network interface board connected to the high speed data bus and further connected to a system bus of the computer and further connected to the data network; wherein

a video board connected to the high speed data bus and further connected to the system bus of the computer and further connected to an audio video device; wherein

said network interface board receives a plurality of data cells from the data network, routes asynchronous signals within the data cells to the computer and further routes synchronous signals to the high speed data bus.

2. The multimedia network system of claim 1, and further including:

a video board connected to the high speed data bus and further connected to the system bus of the computer and further connected to an audio video device; wherein

the video board converts information received on said high speed data bus into conventional video signals and outputs the conventional audio/video signals to an audio/video output device.

3. The multimedia network system of claim 2, wherein:

the video board further accepts signals from an audio/video input device, converts the signals from the audio/video input device into a form acceptable by said high speed data bus, and puts those signals on the high speed data bus.

1 4. The multimedia network system of claim 3,
2 wherein:

3 said network interface board formats signals
4 received from said high speed data bus into
5 asynchronous transfer mode (ATM) cells and further
6 transmits those ATM cells onto the data network.
7

8 5. The multimedia network system of claim 4, wherein:

9 said network interface board further formats
10 asynchronous signals received from the computer into
11 ATM cells and further transmits those ATM cells onto
12 the data network.
13

14 6. The multimedia network system of claim 1, wherein:

15 the data network is a broadband integrated
16 signal and data (BISDN) network.
17

18 7. A data communications device, comprising:

19 a network interface unit for receiving data
20 cells from a network and for transmitting data cells
21 to the network, the network interface unit being
22 connected to a computer such that data cells
23 containing asynchronous data are transmitted to the
24 computer for use therein and for distribution to a
25 local area network to which the computer is further
26 connected.
27

28 8. The data communications device of claim 7, wherein:

29 signals are received at the data communications
30 device as optical signals and are converted therein
31 into electrical signals; and

32 signals to be transmitted from the data
33 communications device are converted from electrical
34 signals into optical signals for transmission via a
35 fiber optic transmission means.
36
37
38
39

- 1 9. The data communications device of claim 7, wherein:
2 data arrives at the data communications device
3 in the form of asynchronous transfer mode (ATM)
4 cells;
5 the ATM cells are reformatted, as appropriate,
6 within the data communications device into
7 synchronous and asynchronous signals and both the
8 synchronous and asynchronous signals are provided to
9 receive data bus such that asynchronous signals can
10 be retrieved from the data bus into a packet memory
11 for use in the manner conventional to the particular
12 type of asynchronous signals.
13
- 14 10. The data communications device of claim 9, and
15 further including:
16 an audio/video unit for receiving synchronous
17 data from said network interface unit and converting
18 the synchronous data into audio and video outputs.
19
- 20 11. The data communications device of claim 10, wherein:
21 the audio/video unit further receives audio and
22 video inputs and converts the audio and video inputs
23 in form for transmission to said network interface
24 unit.
25
- 26 12. The data communications device of claim 10, and
27 further including:
28 a high speed data bus interconnecting said
29 network interface unit and the audio/video unit for
30 transmitting synchronous signals between said network
31 interface unit and the audio/video unit.
32
- 33 13. A method for processing data contained in
34 asynchronous transfer mode (ATM) cell format, comprising:
35 receiving the ATM cells are converting them into
36 electrical signals;
37 reformatting the data into synchronous and
38 asynchronous formats as is appropriate to the
39 particular data;

1 providing asynchronous data to data bus; and
2 transmitting synchronous data via a high speed
3 link to a video processing means for converting the
4 synchronous data into video and audio outputs.

5
6 14. The method of claim 13, wherein:

7 asynchronous data is provided from the data bus
8 to a packet memory for processing as appropriate to
9 the particular packet format of the asynchronous
10 data.

1/6

Fig. 1

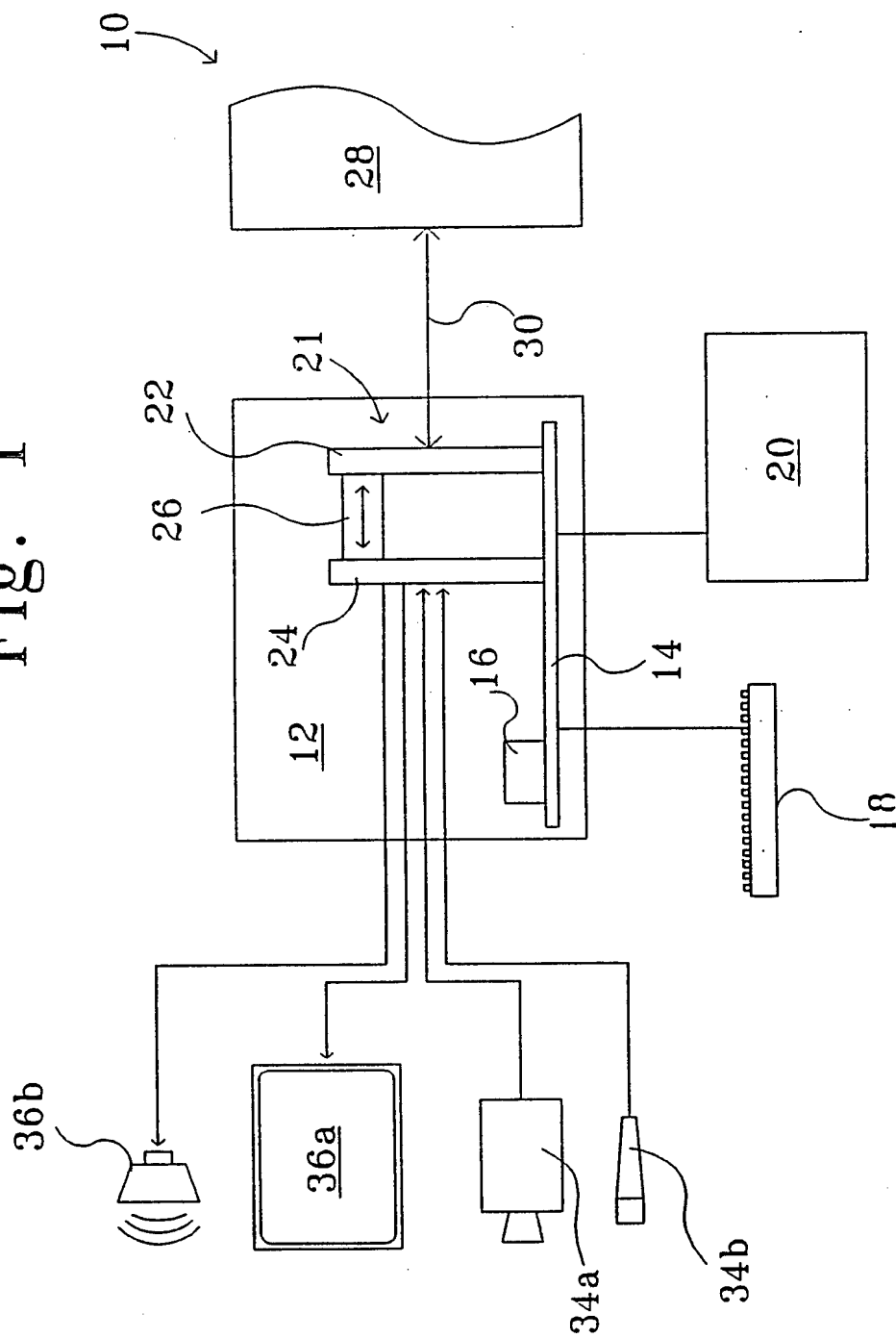


Fig. 2

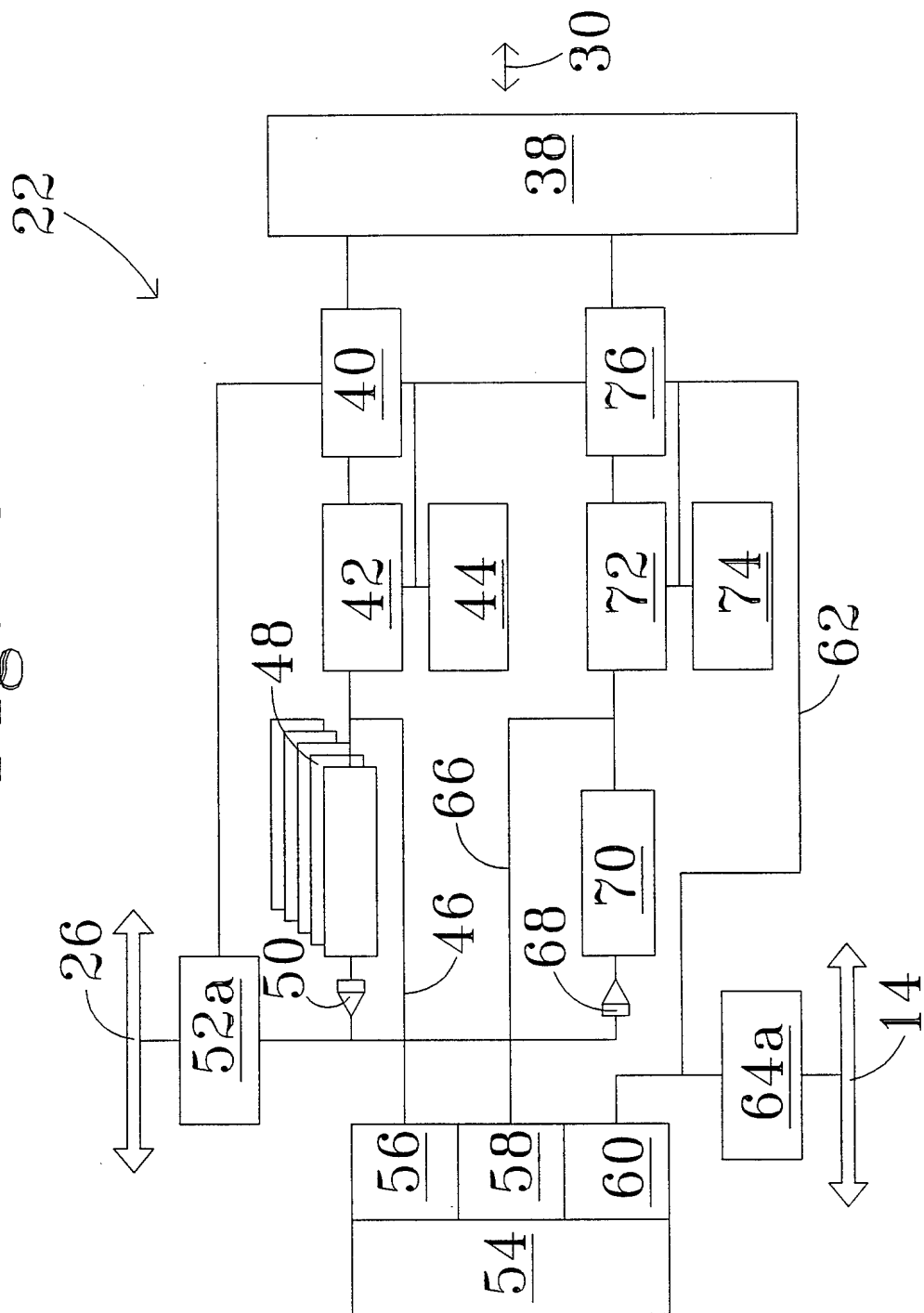
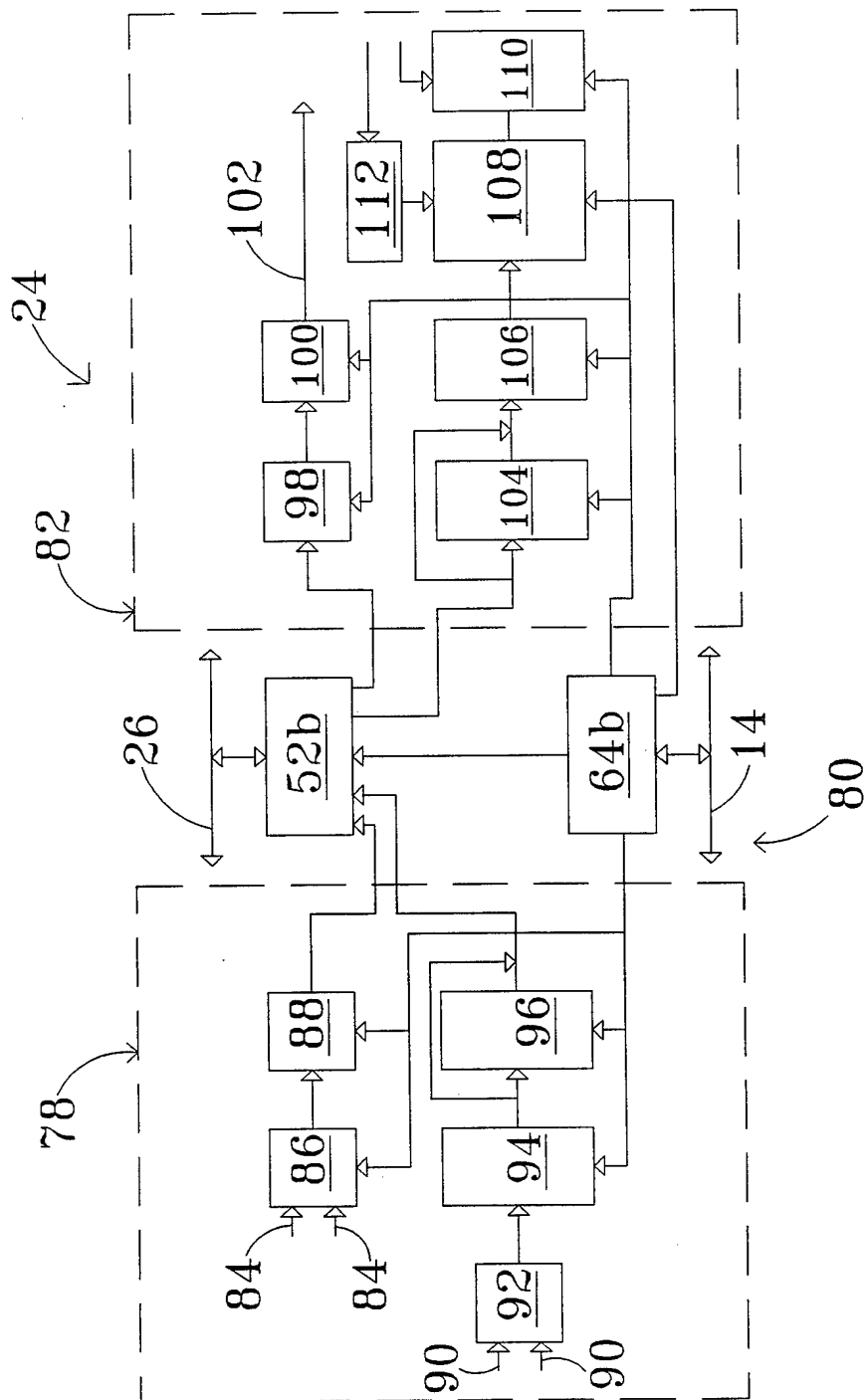


Fig. 3



4/6

Fig. 4

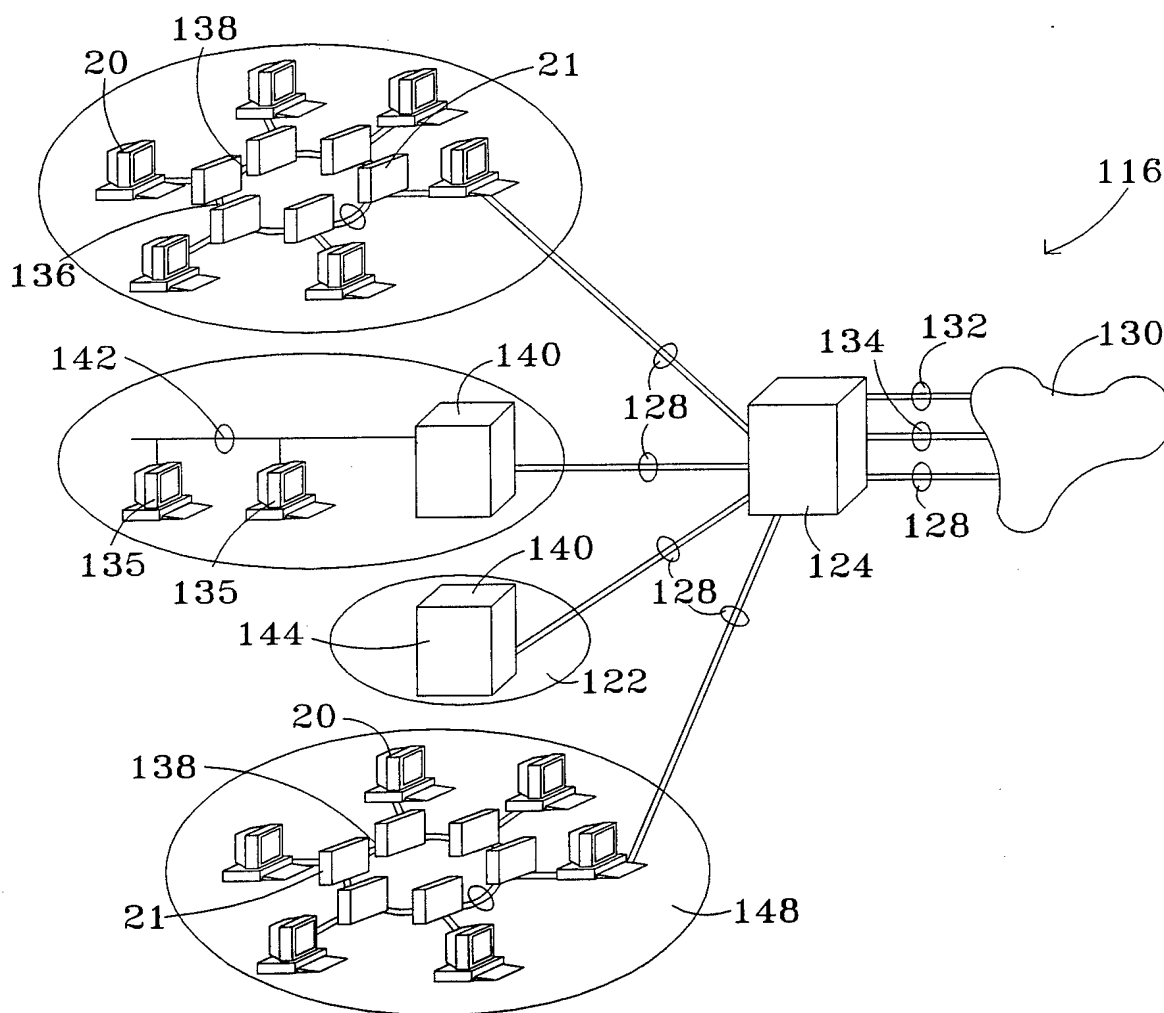


Fig. 5

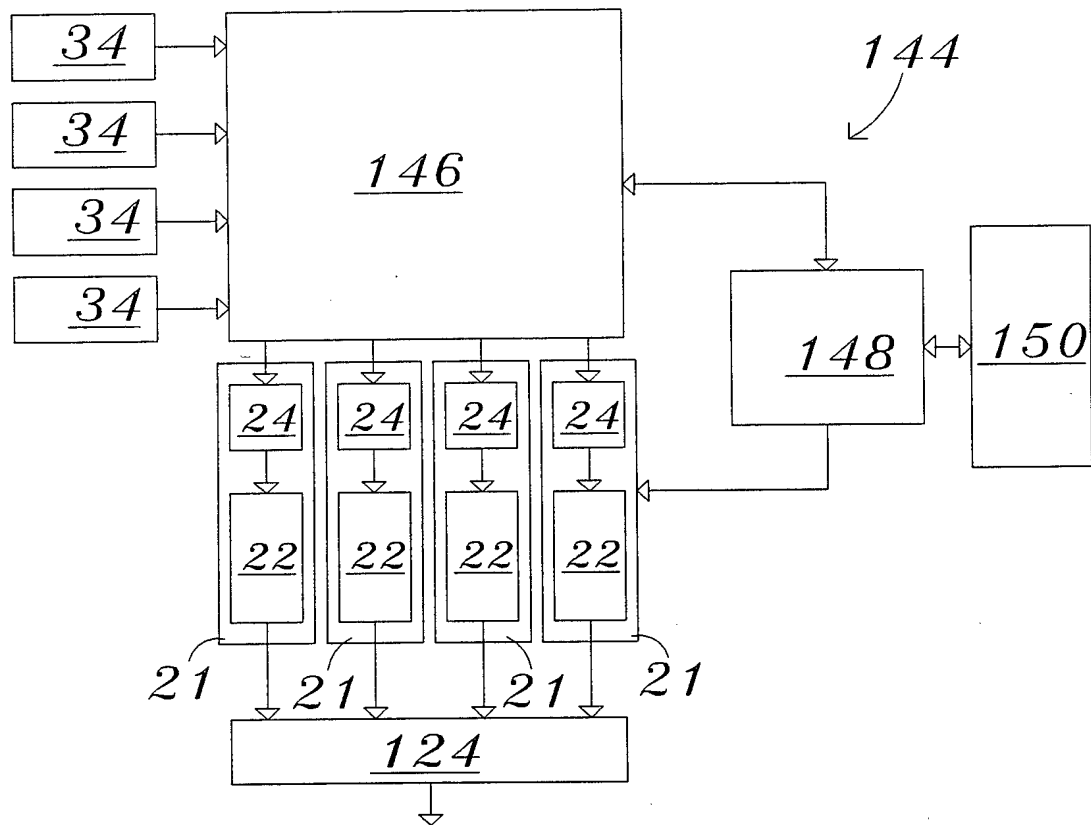
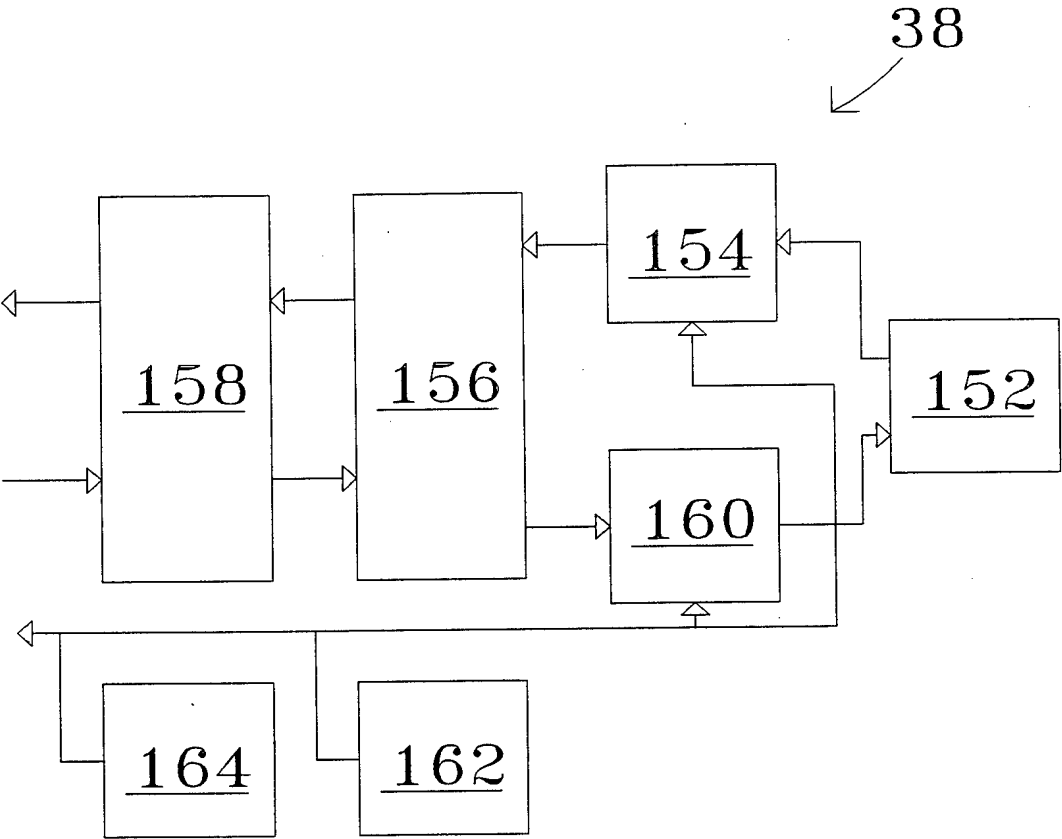


Fig. 6



INTERNATIONAL SEARCH REPORT

International application No. .
PCT/US94/05112**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(5) :G60F 13/00

US CL :395/200, 325

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 395/200, 325

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS

search terms: data bus, system bus, video board, network interface, multimedia, asynchronous, computer, ATM

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y, P	US, A, 5,241,631 (SMITH ET AL) 31 August 1993, col. 2 lines 0-68, col. 3 lines 1-68, col. 4 lines 1-17, figure 2.	1-14
Y, P	US, A, 5,263,139 (TESTA ET AL) 16 November 1993, col. 1 lines 54-68, col. 2 lines 1-41.	1-14
A, P	US, A, 5,274,641 (SHOBATAKE ET AL) 28 December 1993, abstract.	4, 5, 9, 13,
Y, P	US, A, 5,325,423 (LEWIS) 28 January 1994, col. 2 lines 52-68, col. 3 lines 1-27.	1-14
A, P	US, A, 5,230,041 (DINWIDDIE, JR. ET AL) 20 June 1993, col. 3 lines 22-68, col. 4 lines 1-26.	1-14

☐ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

31 AUGUST 1994

Date of mailing of the international search report

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